Pendulum Quiz

Answer the questions below to the best of your ability. AT FIRST, YOU SHOULD WORK ON THIS ALONE. When you have answers (your answers), go to the online Pendulum Quiz and submit them. After you submit your answers, you will get full credit for the quiz, regardless of how well you do. After submitting your initial answers, I recommend that you continue working on the quiz until you *understand* all of it. You may work with classmates after submitting your answers.

A ball is attached to a pin by a massless, inextensible string. The ball is released from rest at point P. Then it follows a path indicated by the dashed curve. Labels P through U refer to locations of the ball at several points along its path.

Notice that at point R along the path, the string is vertical and it just begins to come in contact with a frictionless peg. After the ball reaches point R, the string starts wrapping around the peg. At points P through T, the string is taut. However, at some point between T and U, the string becomes slack.
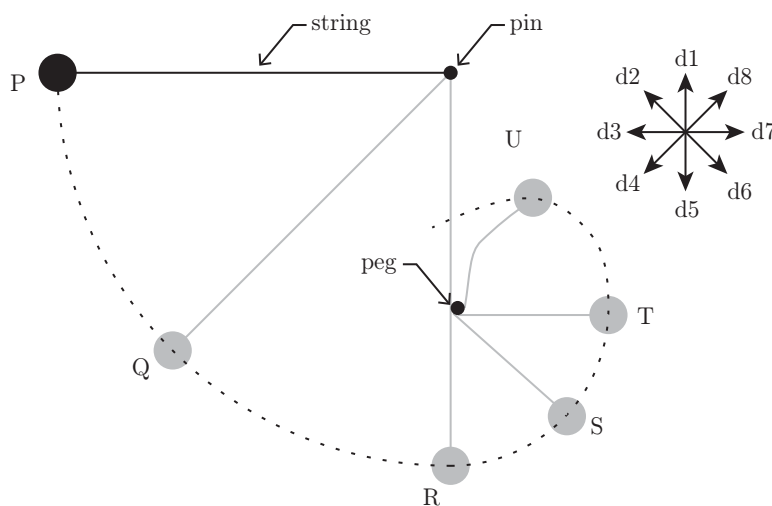
In the following questions, indicate the directions of the velocities and accelerations of the ball at various points along the path. In multiple cases, a velocity or acceleration will not be exactly in one of the directions d1 through d8. In such cases, choose the direction that correspond to the correct components tangent and perpendicular to the path.

1. Immediately after the ball is released at point P, in which direction is the *velocity?*

    A. d1,   B. d2,   C. d3,   D. d4,   E. d5,   F. d6,   G. d7,   H. d8,   I. zero velocity.

2. Immediately after the ball is released at point P, in which direction is the *acceleration?*

    A. d1,   B. d2,   C. d3,   D. d4,   E. d5,   F. d6,   G. d7,   H. d8,   I. zero accel.

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3. When the ball reaches point Q, in which direction is the *velocity?*

    A. d1,   B. d2,   C. d3,   D. d4,   E. d5,   F. d6,   G. d7,   H. d8,   I. zero velocity.

4. When the ball reaches point Q, in which direction is the *acceleration?*

    A. d1,   B. d2,   C. d3,   D. d4,   E. d5,   F. d6,   G. d7,   H. d8,   I. zero accel.

5. Immediately *before* the ball reaches point R, in which direction is the *velocity?*

   A. d1,   B. d2,   C. d3,   D. d4,   E. d5,   F. d6,   G. d7,   H. d8,   I. zero velocity.

6. Immediately *after* the ball reaches point R, in which direction is the *velocity?*

   A. d1,   B. d2,   C. d3,   D. d4,   E. d5,   F. d6,   G. d7,   H. d8,   I. zero velocity.

7. Let v_- and v_+ be the speeds of the ball just before and just after point R respectively. Which is larger?

   A. $v_- < v_+$,   B. $v_- > v_+$,   C. $v_- = v_+$,

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8. Immediately *before* the ball reaches point R, in which direction is the *acceleration?*

   A. d1,   B. d2,   C. d3,   D. d4,   E. d5,   F. d6,   G. d7,   H. d8,   I. zero accel.

9. Immediately *after* the ball reaches point R, in which direction is the *acceleration?*

   A. d1,   B. d2,   C. d3,   D. d4,   E. d5,   F. d6,   G. d7,   H. d8,   I. zero accel.

10. Let a_- and a_+ be the magnitudes of the acceleration of the ball just before and just after point R respectively. Which is larger?

    A. $a_- < a_+$,   B. $a_- > a_+$,   C. $a_- = a_+$,

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11. When the ball reaches point S, in which direction is the *velocity?*

    A. d1,   B. d2,   C. d3,   D. d4,   E. d5,   F. d6,   G. d7,   H. d8,   I. zero velocity.

12. When the ball reaches point S, in which direction is the *acceleration?*

    A. d1,   B. d2,   C. d3,   D. d4,   E. d5,   F. d6,   G. d7,   H. d8,   I. zero accel.

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13. When the ball reaches point T, in which direction is the *velocity?*

    A. d1,   B. d2,   C. d3,   D. d4,   E. d5,   F. d6,   G. d7,   H. d8,   I. zero velocity.

14. When the ball reaches point T, in which direction is the *acceleration?*

    A. d1,   B. d2,   C. d3,   D. d4,   E. d5,   F. d6,   G. d7,   H. d8,   I. zero accel.

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15. When the ball reaches point U, in which direction is the *velocity?*

    A. d1,   B. d2,   C. d3,   D. d4,   E. d5,   F. d6,   G. d7,   H. d8,   I. zero velocity.

16. When the ball reaches point U, in which direction is the *acceleration?*

    A. d1,   B. d2,   C. d3,   D. d4,   E. d5,   F. d6,   G. d7,   H. d8,   I. zero accel.