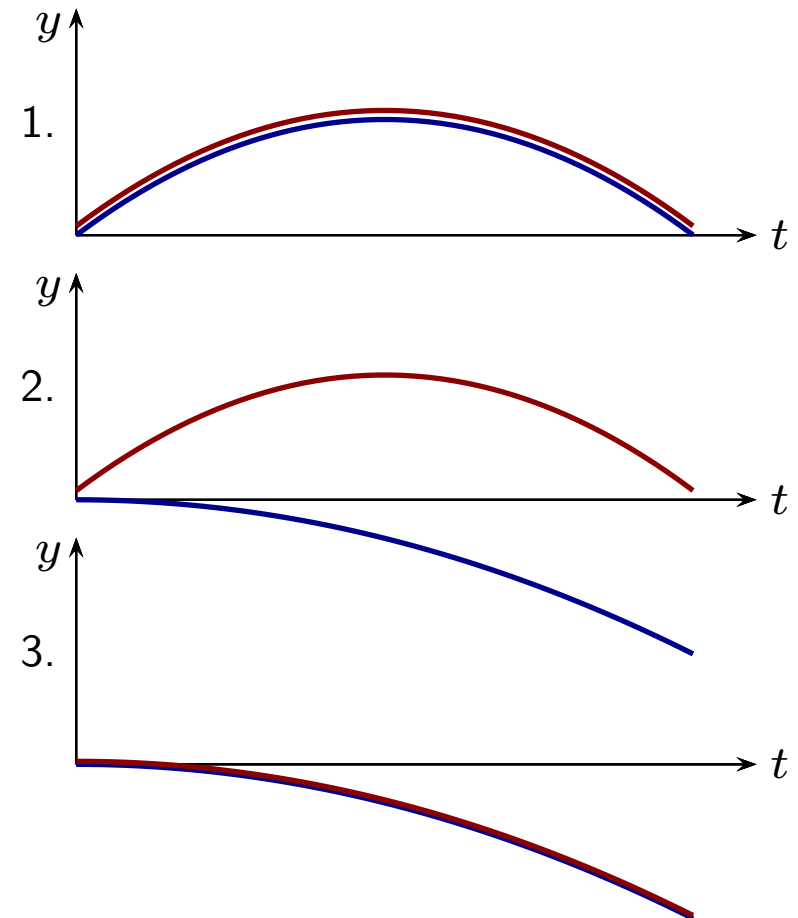# Question 1

One observer, Yvonne, is at rest with respect to the earth and throws a ball up with initial speed $10\,\mathrm{m/s}$. According to her the ball moves up and down, accelerating under the influence of gravity. She records the vertical position of the ball as time passes. Another observer, Zach, flies in a small helicopter at a constant speed of $10\,\mathrm{m/s}$ upward. Zach observes the ball from a frame of reference in which he is at rest and records the vertical position of the ball as time passes.

Which of the following best represents the graphs (Yvonne uses red, Zach blue) of vertical position vs. time?

Question 2

Zach is in a glass-sided elevator and holds a ball. Zach observes the ball from frame of reference at rest with respect to the elevator. Yvonne observes the ball from a frame of reference at rest with respect to the Earth. At a crucial moment the elevator cable snaps and the elevator falls freely, Zach lets go of the ball.

Which of the following is true?

1. Yvonne and Zach observe each the ball fall with a constant downward acceleration of g.

2. Yvonne observes the ball fall with a constant downward acceleration of g. Zach observes the ball fall with $a = 0\,\mathrm{m/s^2}$.

3. Zach observes the ball fall with a constant downward acceleration of g. Yvonne observes the ball fall with $a = 0\,\mathrm{m/s^2}$.

4. Both observe the ball fall with $a = 0\,\mathrm{m/s^2}$.

5. None of the above.

Question 3

Two inertial observers Yvonne and Zach travel in rockets in outer space relative to each other. They observe a ball which Yvonne throws horizontally from the left end of her rocket to the right end of her rocket. They both observe the two events:

Event 1: Ball leaves left end.

Event 2: Ball hits right end.

Which of the following is true?

1. Y and Z agree on the distance traveled in all cases.

2. Y and Z agree on the distance traveled when Z travels horizontally right but not other cases.

3. Y and Z agree on the distance traveled when Z travels horizontally left but not other cases.

4. Y and Z agree on the distance traveled when Z travels vertically but not other cases.