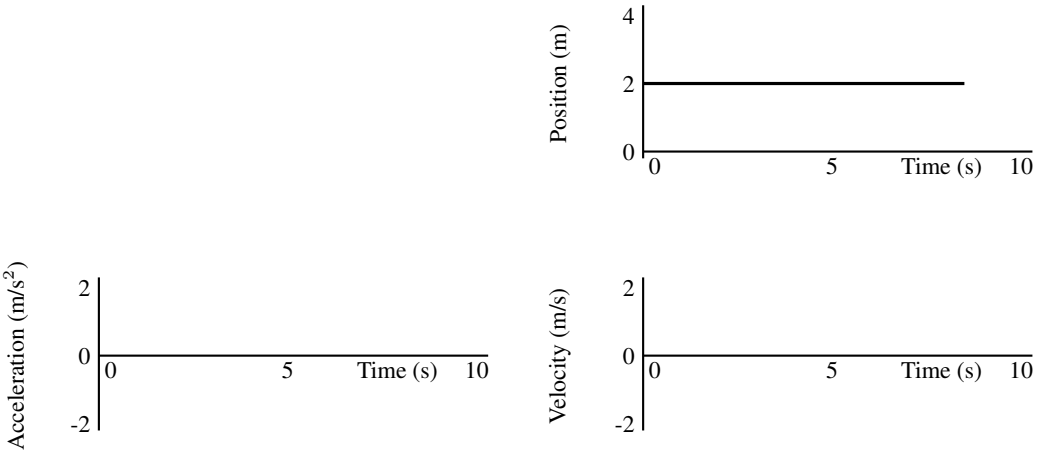
1 Part 1

For each of the 6 figures that follow, one plot is given. Use your knowledge of 1D motion to fill in the other two plots, as well as writing a short verbal description of the motion.

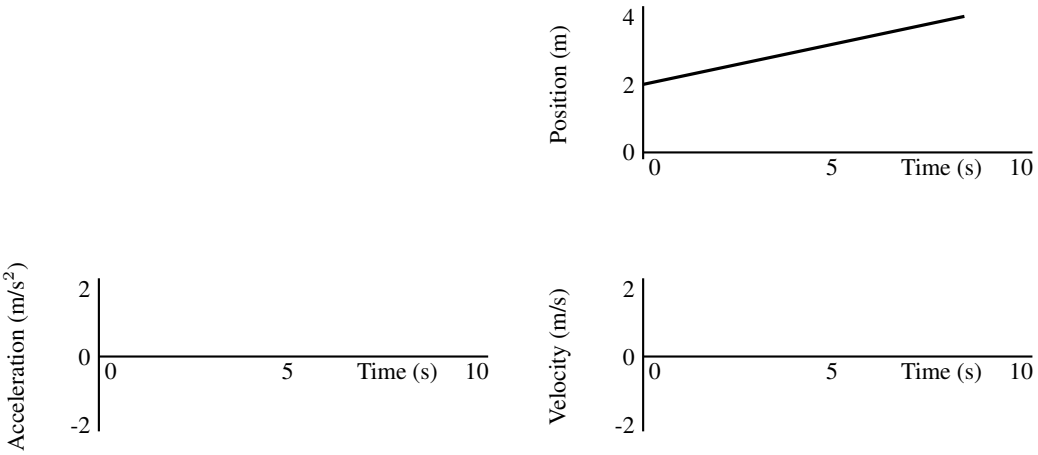
a.

Description of motion:



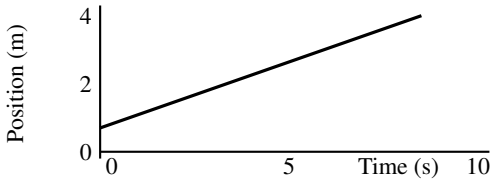
b.

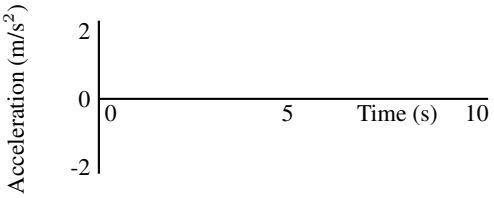
Description of motion:

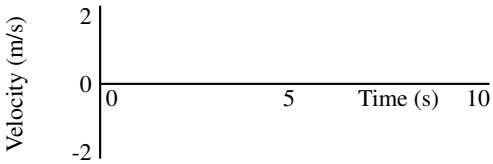


c.

Description of motion:







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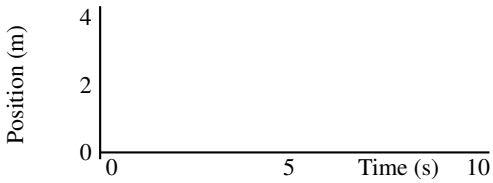
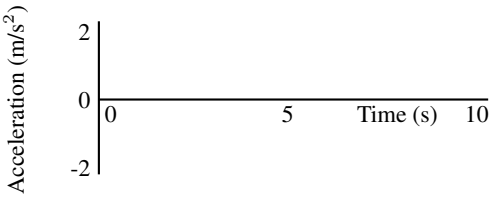
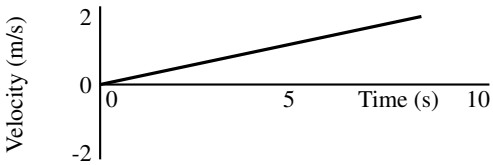
d. (assume $x_0 = 0$)

Description of motion:







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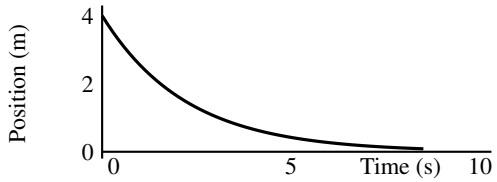
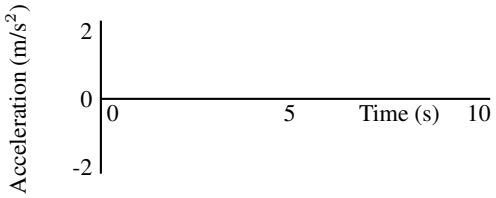
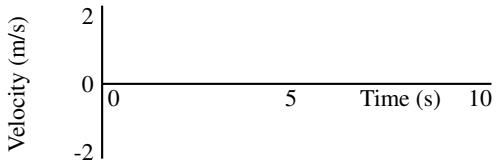
e.

Description of motion:







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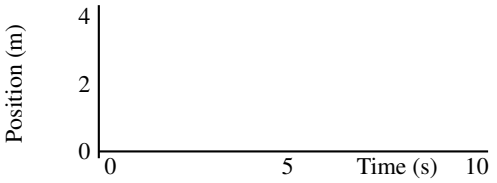
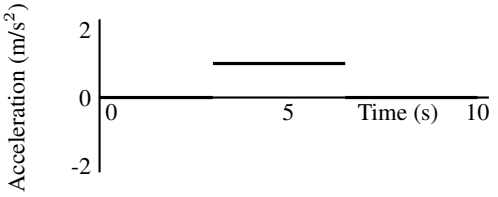
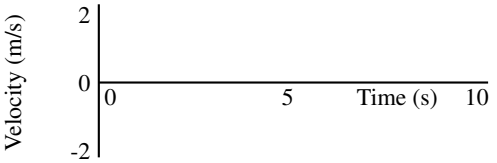
f. (assume $x_0 = 0$ & $v_0 = 0$)

Description of motion:







Part 2

A $13\ \mathrm{kg}$ ball is launched upward into the negligibly thin atmosphere of Titan at an initial velocity of $18\ \frac{m}{s}$. The gravity of Titan, being significantly weaker than Earth, causes a constant downward acceleration of $1.352\ \frac{m}{s^2}$.

1. Sketch a diagram of what happens.
2. Sketch the x vs t, v vs t, and a vs t graphs for the motion.
3. What is the ball's maximum height?
4. How long until the ball hits the ground?

Part 3

The ball now has a small rocket attached to the bottom that supplies a constant acceleration of $5\frac{m}{s^2}$. The rocket was bought from PhysicsMart, Inc., so it adds no mass to the projectile. Due to the small fuel contained, it only supplies thrust for 30 seconds. The ball is now launched from rest. Repeat steps 1-4 for the new scenario.

Part 4

Suppose that you throw a ball upward from the surface of some arbitrary planet with no atmosphere. After half of the time to the highest point, the ball has covered:

1. half the distance to the top
2. more than half the distance to the top
3. less than half the distance to the top
4. it depends how fast you throw the ball.

Part 5

For the previous question, use your knowledge of kinematics to derive exactly what fraction of the distance to the top the ball covers in half the time to the highest point.

Part 6

(a) A ball is dropped, and then another ball is dropped from the same spot one second later. As time goes on while the balls are falling, the distance between them (ignoring air resistance):

1. decreases
2. remains the same
3. increases and approaches a limiting value
4. increases steadily

(b) Now prove your answer to (a) by writing down the equations of motion for both objects starting from the moment the second ball is dropped, and computing their difference.

(c) Now consider part (a) from previous question but *with* air resistance. What answer would you pick now? Explain your thinking!