Test 1: *1 D Motion*

Equations and constants:

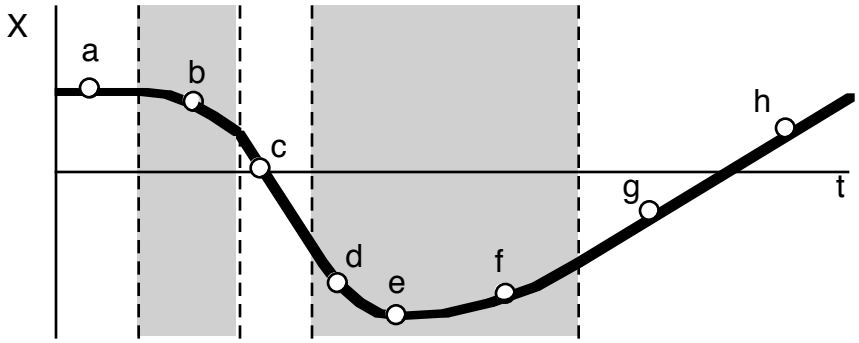
$\bar{v} = \frac{\Delta x}{\Delta t}$ $\bar{v} = \frac{(v_i + v_f)}{2}$ $v = \frac{dx}{dt}$ $\bar{a} = \frac{\Delta v}{\Delta t}$ $a = \frac{dv}{dt}$

$x = \frac{1}{2}at^2 + v_i t + x_i$ $v = at + v_i$ $v_f^2 = v_i^2 + 2a\Delta x$ $|g| = 10\ m/s^2$

Multiple Choice: *Choose the letter of the best answer. 3 points each.*

Unless otherwise noted, ignore the effects of air resistance.

Questions 1 to 6 refer to the following position vs. time graph. The shaded regions are curved, the others are straight.



1. _____ At which point(s) is the velocity constant?

2. _____ At which point(s) is the object slowing down?

3. _____ At which point(s) is the object changing directions?

4. _____ At which point(s) is the velocity negative?

5. _____ At which point(s) is the object going forwards?

6. _____ At which point(s) is the acceleration positive?

7. _____ What did Galileo discover by rolling spheres down inclined planes?
   a. Objects roll with a constant speed.
   b. That gravity caused a constant acceleration.
   c. That gravity made everything speed up.
   d. The acceleration due to gravity was 9.8 m/s^2.

8. _____ Everybody knows that if you toss a tennis ball up in the air, it will stop at its highest point. What is true about its acceleration of the tennis ball at its highest point?
   a. The acceleration is constant throught the motion of the tennis ball.
   b. It will also be zero because the tennis ball is not moving.
   c. It will be changing directions because gravity was making the tennis ball slow down and is about to make it speed up.
   d. I am not sure because we never talked about tennis balls in class.

9. _____ What is your acceleration if you speed up at a constant rate of 4 m/s every second for 5 seconds?
   a. 20 m/s^2. b. 4 m/s^2. c. 0.8 m/s^2. d. 0 m/s^2.

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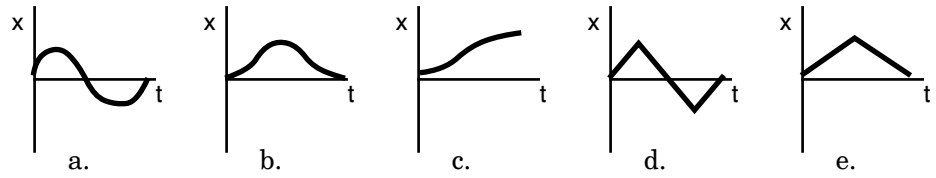
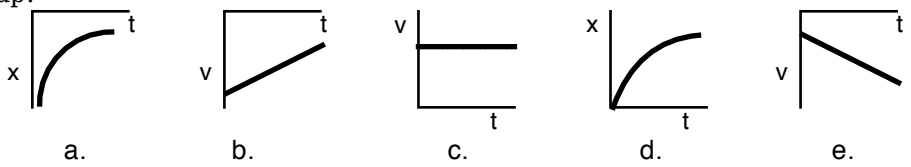
10. _____ Which of the following motion graphs best represents an object that starts from rest, speeds up and slows down forwards and then speeds up and slows down backwards, finally stopping where it started?



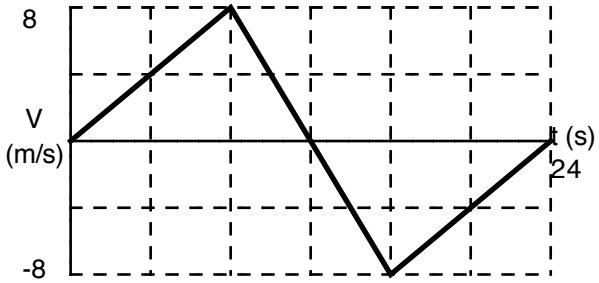
11. _____ Which of the following graphs could represent something going backwards and speeding up?



12. _____ The position as a function of time (in SI units) for an object is given by the expression $x = 4t^3 - 6t^2 - 3t - 10$. Which of the following statements is false?
   a. There is a constant acceleration of –12 m/s^2.
   b. The initial position is –10 m.
   c. The initial velocity is –3 m/s.
   d. The object goes forward and backward.
   e. The velocity is zero at some point in time.

13. _____ If you throw a ball up in the air with a speed of 15 m/s, how many seconds will it take for the ball to reach its maximum height?
   a. 15 s. b. 10 s. c. 5 s. d. 3 s. e. 1.5 s.

Questions 14 to 15 refer to the following graph:



14. _____ What is the average velocity for the entire motion shown?
   a. 0 m/s. b. 4 m/s. c. 8 m/s. d. 24 m/s. e. 48 m/s.

15. _____ What is the acceleration at t = 12 seconds?
   a. 0 m/s^2. b. -2 0 m/s^2. c. -4 0 m/s^2. d. 4 0 m/s^2. e. 8 0 m/s^2.

16. _____ If you dropped a 1 pound rock and a 10 pound rock at the same time from a second floor window, what would happen?
   a. The 10 pound rock would be going 10 times faster, and so hit the ground well ahead of the 1 pound rock.
   b. They would fall with constant speeds - with the 10 pound rock hitting the ground the first.
   c. The 10 pound rock would have a bigger accleration because it is heavier, and so hit the ground noticably sooner.
   d. They would hit the ground at basically the same time.

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17. _____ A car constantly accelerates from rest to a speed of 40 m/s in 10 seconds. How far does it travel in that time?
    a. 200 m. b. 400 m. c. 800 m. d. 1600 m. e. can't tell.

Problem Solving: *Show all work.*
Unless otherwise noted, ignore the effects of air resistance.

18. The position of an object moving in a straight line along the x axis is given by $x = 3t - 4t^2 + t^3$.
    a. What is the average velocity of the object from t = 1 to t = 3 seconds?

    b. What is the acceleration of the object at t = 3 seconds?

19. On a strange planet, a ball is thrown up in the air with an initial velocity of 25 m/s. After 4.1 seconds, it has a speed of 3 m/s, and is traveling down. What was the maximum height of the ball?

20. A speeding car (v = 45 m/s) goes by a police car at rest on the highway. The police then constantly accelerate at 3.1 m/s^2 to a top speed of 50 m/s. How many seconds will it take the police car to catch the speeding car?

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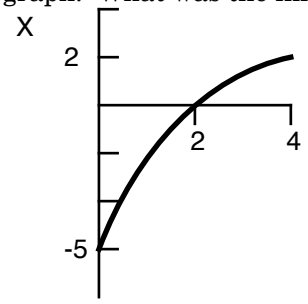
21. The position as a function of time for an object with a constant acceleration is shown in the graph. What was the initial velocity of the object?



22. An object constantly accelerates from rest, reaching a speed of v after a distance of 4.5 meters. How much further must it travel to reach a speed of $2v$?