Test 1: *1 D Motion*

Equations and constants:

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

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

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

Unless otherwise noted, ignore the effects of air resistance.

Questions 1 and 2 refer to the following:

The position as a function of time for an object is given by $x = t^3 - 6t^2 + 5t - 11$, where x is in meters and t is in seconds.

1. _____ What is the initial velocity of the object?
   a. –12 m/s. b. –11 m/s. c. –6 m/s. d. 3 m/s. e. 5 m/s.

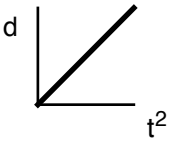
2. _____ Which of the following statements is true?
   a. The object has a constant acceleration of –12 m/s^2.
   b. The object is always moving forwards.
   c. The object is initially going backwards.
   d. The object has an absolute maximum distance away from its initial position.
   e. The object is initially slowing down.

3. _____ If your velocity and acceleration are both negative, then you must be
   a. slowing down and going backwards. b. speeding up and going backwards.
   c. slowing down and going forwards. d. speeding up and going forwards.
   e. Huh? It can't even happen!

4. _____ Can you accelerate and have a constant speed?
   a. Of course not, because you are speeding up if you accelerate.
   b. No, because acceleration is the rate at which your speed changes.
   c. Sure, as long as you are changing direction of travel.
   d. Yes, this happens when a tossed object reaches its maximum height and changes direction.
   e. None of those are completely correct.

5. _____ The acceleration of an object is given by the expression $a = 4t$. Which of the following would be an expression for the velocity?
   a. $v = 4t^2 + v_i$ b. $v = 2t^2 + v_i$ c. $v = 4t + v_i$
   d. $v = 4t + 4v_i$ e. $v = 4$

6. _____ After dropping an object from a variety of initial heights and measuring the time it took to fall, some students on a distant planet produce the graph shown at the right. The slope of the line is 4. (Standard SI units.) What is the acceleration due to gravity on the planet?
   a. 4 m/s^2. b. 8 m/s^2. c. 2 m/s^2.
   d. can't tell from the graph.



7. _____ A friend holds a ruler and drops it through your fingers. You try and close your fingers as soon as you see it drop. The ruler falls 9 cm in this little "experiment." What was your reaction time?
   a. 0.32 s. b. 0.018 s. c. 0.095 s. d. 0.13 s.

8. _____ If you speed up from 20 mph to 50 mph in 8 seconds, what is your acceleration?
   a. 6.25 mph/s. b. 4.38 mph/s. c. 3.75 mph/s.
   d. none of those are right because the units are all messed up.

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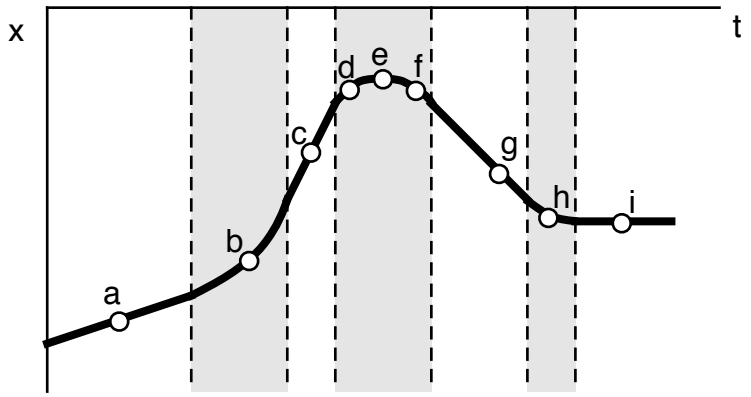
Questions 9 to 14 refer to the following position vs. time graph. The shaded regions are curved, the others are straight. Point e is a maximum.



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

10. _____ At which point(s) is the object moving backwards?

11. _____ At which point(s) does the object have a positive acceleration?

12. _____ At which point(s) is the object moving forwards with a constant speed?

13. _____ At which point(s) is the object moving the fastest?

14. _____ At which point(s) does the object have a speed of zero?

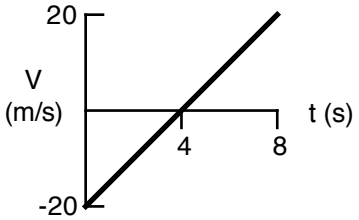
Questions 15 to 17 refer to the following:
A ball is thrown up in the air with an initial speed of 30 m/s. It is caught at the same height from which it was thrown.

15. _____ How many seconds was it in the air?
a. 0 s. b. 3 s. c. 6 s. d. 10 s.

16. _____ What was its maximum height?
a. 180 m. b. 90 m. c. 45 m. d. 11.25 m.

17. _____ What is its acceleration at its maximum height?
a. 10 m/s^2 down. b. 10 m/s^2 up.
c. 10 m/s^2 neither up nor down. d. 0 m/s^2.

18. _____ The velocity as a function of time for an object is shown to the right. What is the acceleration of the object at t = 4 seconds?
a. 0 m/s^2. b. 2.5 m/s^2. c. 5 m/s^2.
d. 8 m/s^2. e. None of those are correct.



19. _____ If you drop a 1 kg lead ball and a 2 kg lead ball off the top of the high school at the same time, which would hit the ground first?
a. the 1 kg ball. b. the 2 kg ball. c. they hit at the same time.
d. this can't be done because Mr. Dorrey would cath you before you could drop them.

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

20. You toss a tennis ball straight up in the air with an initial speed of 22 m/s. What is its speed when it is halfway to its maximum height? (Assume the initial height was 0.)

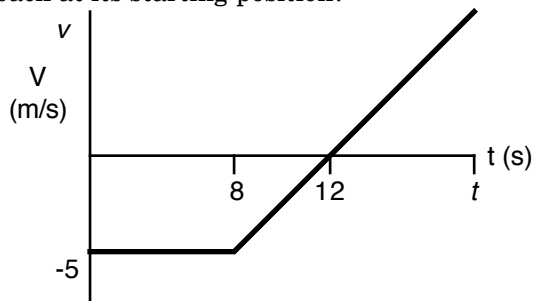
21. The position as a function of time for an object is given by the expression (in SI units)

$$x = 2t^3 - 6t^2 + 10t$$

a. When is its acceleration equal to 0?

b. What is its average velocity for the first 4 seconds?

22. An object has the velocity vs time graph shown in the diagram below.At what time *t* is the object back at its starting position?



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23. A and B are 150 meters apart. A has an initial speed of 20 m/s to the right and is slowing down at a constant rate of 2.5 m/s^2. B has an initial velocity of v_i, and is slowing down at a constant rate of a. What is the initial velocity and acceleration of B so that the two objects meets when they both have a velocity of zero?