AP PHYSICS

Name: ______________________________

Period: _______ Date: _________________

DEVIL PHYSICS

BADDEST CLASS ON CAMPUS

AP EXAM		CHAPTER TEST	
50 Multiple Choice • 45 Single Response • 5 Multi-Response	90 min, 1 point each	25 Multiple Choice • 22 Single Response • 3 Multi-Response	45 min
Free Response • 3 Short Free Response • 2 Long Free Response	90 min • 13 min ea, 7 pts ea • 25 min ea, 12 pts ea	Free Response • 2 Short Free Response • 1 Long Free Response	45 min • 12 min ea, 7 pts ea • 20 min ea, 12 pts ea

CHAPTER 2 TEST REVIEW -- ANSWER KEY

1. An object moving in the +x-axis experiences an acceleration of 2.0 m/s^2 . This means the object is
   a. traveling 2.0 m in every second
   b. traveling at 2.0 m/s in every second
   c. changing its velocity by 2.0 m/s
   d. increasing its velocity by 2.0 m/s in every second

   Answer: D

2. Can an object's velocity change direction when its acceleration is constant? Support your answer with an example.
   a. No, this is not possible because it is always speeding up
   b. No, this is not possible because it is always speeding up or slowing down, but it can never turn around
   c. Yes, this is possible, and a rock thrown straight up is an example
   d. Yes, this is possible, and a car that starts from rest, speeds up, slows to a stop, and then backs up is an example

   Answer: C

3. Objects A and B both start at rest. They both accelerate at the same rate. However, object A accelerates for twice the time as object B. What is the final speed of object A compared to that of object B?
   a. the same speed
   b. twice as fast
   c. three times as fast
   d. four times as fast

   Answer: B

4. When an object is released from rest and falls in the absence of friction, which of the following is true concerning its motion?
   a. The speed of the falling object is proportional to its mass
   b. The speed of the falling object is proportional to its weight
   c. The speed of the falling object is inversely proportional to its surface area
   d. None of the above is true.

   Answer: D

5. Suppose a ball is thrown straight up. Make a statement about the velocity and the acceleration when the ball reaches the highest point.
   a. Both its velocity and its acceleration are zero
   b. Its velocity is zero and its acceleration is not zero
   c. Its velocity is not zero and its acceleration is zero
   d. Neither its velocity nor its acceleration is zero

   Answer: B
6. Suppose a skydiver jumps from a high-flying plane. What is her acceleration when she reaches terminal velocity?
   a. It is essentially zero
   b. It is in the upward direction
   c. It is approximately 9.8 m/s^2 downward
   d. It is constantly pointing upward

   Answer: A
7.
8. An object is moving with constant non-zero velocity in the +x-axis. The position versus time graph of this object is
   a. a horizontal straight line
   b. a vertical straight line
   c. a straight line making an angle with the time axis
   d. a parabolic curve

   Answer: C
9. The slope of a position versus time graph gives
   a. position
   b. velocity
   c. acceleration
   d. displacement

   Answer: B
10. The area under a curve in an acceleration versus time graph gives
   a. position
   b. velocity
   c. acceleration
   d. displacement

   Answer: B
11. If the velocity versus time graph of an object is a horizontal line, the object is
   a. moving with constant non-zero speed
   b. moving with constant non-zero acceleration
   c. at rest
   d. moving with infinite speed

   Answer: A

12. A runner ran the marathon (approximately 42.0 km) in 2 hours 57 minutes. What is the average speed of the runner in m/s?

a. 14.2 x 103 m/s

b. 124 m/s

c. 3.95 m/s

d. 14.2 m/s

Answer: C

2 hours 57 minutes = 177 min

$$\frac{42km}{177min} x \frac{1min}{60s} x \frac{1000m}{1km} = 3.95m/s$$

13. A ly (light year) is the distance that light travels in one year. The speed of light is 3.00 x 10^8 m/s. How many miles are there in a ly? (1mi = 1609m, 1yr = 365days)

a. 9.46 x 10^{12} mi

b. 9.46 x 10^{15} mi

c. 5.88 x 10^{12} mi

d. 5.88 x 10^{15} mi

Answer: C

$$\frac{3x10^8 m}{1s} x \frac{1yr}{1} x \frac{365d}{1yr} x \frac{24hr}{1d} x \frac{3600s}{1hr} x \frac{1mi}{1609m} = 5.88x10^{12}$$

14. A polar bear starts at the North Pole. It travels 1.0km south, then 1.0km east, then 1.0km north, then 1.0km west to return to its starting point. This trip takes 45 min. What was the bear's average velocity?

a. 0 km/hr

b. 0.09 km/hr

c. 4.5 km/hr

d. 5.3 km/hr

Answer: A

Since the end point is the same as the starting point, Δx is zero so velocity is zero.

15. An airplane travels at 300 mi/h south for 2.00 h and then at 250 mi/h north for 750 miles. What is the average speed for the trip?

a. 260 mi/h

b. 270 mi/h

c. 275 mi/h

d. 280 mi/h

Answer: B

Leg 1

t = 2.00 h

d = 300 mi/h x 2 h = 600 mi

Leg 2

t = 750 mi ÷ 250 mi/h = 3.00 h

d = 750 mi

Total

t = 2.00 h + 3.00 h = 5.00 h

d = 600 mi + 750 mi = 1350 mi $\frac{1350 \text{ mi}}{5.00 \text{ h}} = 270 \text{ mi/h}$

16. In a 400-m relay race the anchorman (the person who runs the last 100m, not Ron Burgundy) for Team A can run 100m in 9.8s. His rival, the anchorman for Team B (also not Ron Burgundy), can cover 100m in 10.1s. What is the largest lead the Team B runner can have when the Team A runner starts the final leg of the race, in order that the Team A runner catches the Team B runner by the end of the race?
   a. 2.0 m
   b. 3.0 m
   c. 4.0 m
   d. 5.0 m

   Answer: B

   $$vt = d$$
   $$t = \frac{d}{v}$$
   $$t_A = t_B$$
   $$\frac{d_A}{v_A} = \frac{d_B}{v_B}$$
   $$d_B = \frac{v_B d_A}{v_A} = \frac{\left(\frac{\cancel{100}}{10.1}\right)(100)}{\left(\frac{\cancel{100}}{9.8}\right)} = \frac{(100)(9.8)}{10.1} = 97m$$

   Runner B can cover 97m in the time Runner A can cover 100m, so if his lead is not more 3m, the Team A runner can catch him.

17. A cart starts from rest and accelerates at 4.0 m/s^2 for 5.0 s, then maintains that velocity for 10 s, and then decelerates at the rate of 2.0 m/s^2 for 4.0 s. What is the final speed of the car?
   a. 20 m/s
   b. 16 m/s
   c. 12 m/s
   d. 10 m/s

   Answer: C

   $$v = v_0 + at = 0 + (4)(5) = 20m/s$$
   $$v = v_0 + at = 20 + (-2)(4) = 12m/s$$

18.

19. A jet fighter plane is launched from a catapult on an aircraft carrier. It reaches a speed of 42 m/s at the end of the catapult, and this requires 2.0 s. Assuming the acceleration is constant, what is the length of the catapult?
   a. 16 m
   b. 24 m
   c. 42 m
   d. 84 m

   Answer: C

   $$v = v_0 + at$$
   $$\frac{v - v_0}{t} = a = \frac{42}{2} = 21m/s^2$$
   $$v^2 = {v_0}^2 + 2a(x - x_0)$$

$$\frac{v^2}{2a} = x = \frac{42^2}{2x21} = 42m$$

20. A car starts from rest and accelerates uniformly at 3.0 m/s^2. A second car starts from rest 6.0 s later at the same point and accelerates uniformly at 5.0 m/s^2. How long does it take the second car to overtake the first car?
    a. 12 s
    b. 19 s
    c. 21 s
    d. 24 s

    Answer: C

    $$x = x_0 + v_0 t + 1/2\, at^2$$
    $$x = 1/2\, at^2$$
    $$x_A = x_B$$
    $$1/2\, a_A(t+6)^2 = 1/2\, a_B t^2$$
    $$3(t+6)^2 = 5t^2$$
    $$3t^2 + 36t + 108 = 5t^2$$
    $$0 = 2t^2 - 36t - 108$$
    $$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
    $$t = \frac{36 \pm \sqrt{(-36)^2 - 4(2)(-108)}}{2(2)}$$
    $$t = \frac{36 \pm 46.5}{4} = 20.6, -2.62$$

21. An object is thrown upward with a speed of 12 m/s on the surface of planet X where the acceleration due to gravity is 1.5 m/s^2. How long does it take for the object to reach the maximum height?
    a. 8.0 s
    b. 11 s
    c. 14 s
    d. 16 s

    Answer: A

    $$v = v_0 + at$$
    $$0 = v_0 + at$$
    $$-at = v_0$$
    $$t = \frac{v_0}{-a} = \frac{12}{-(-1.5)} = 8s$$

22. An object is thrown upward with a speed of 14 m/s on the surface of planet X where the acceleration due to gravity is 3.5 m/s^2. What is the speed of the object after 8.0 s?
    a. 7.0 m/s
    b. 14 m/s
    c. 21 m/s
    d. 64 m/s

Answer: B

$v = v_0 + at$ $v = 14 + (-3.5)(8) = -14m/s$ **speed has no direction**

23. A ball is thrown straight up with a speed of 36.0 m/s. How long does it take to return to its starting point?
    a. 3.67 s
    b. 7.35 s
    c. 11.0 s
    d. 14.7 s

Answer: B

$x = x_0 + v_0 t + 1/2\, at^2$

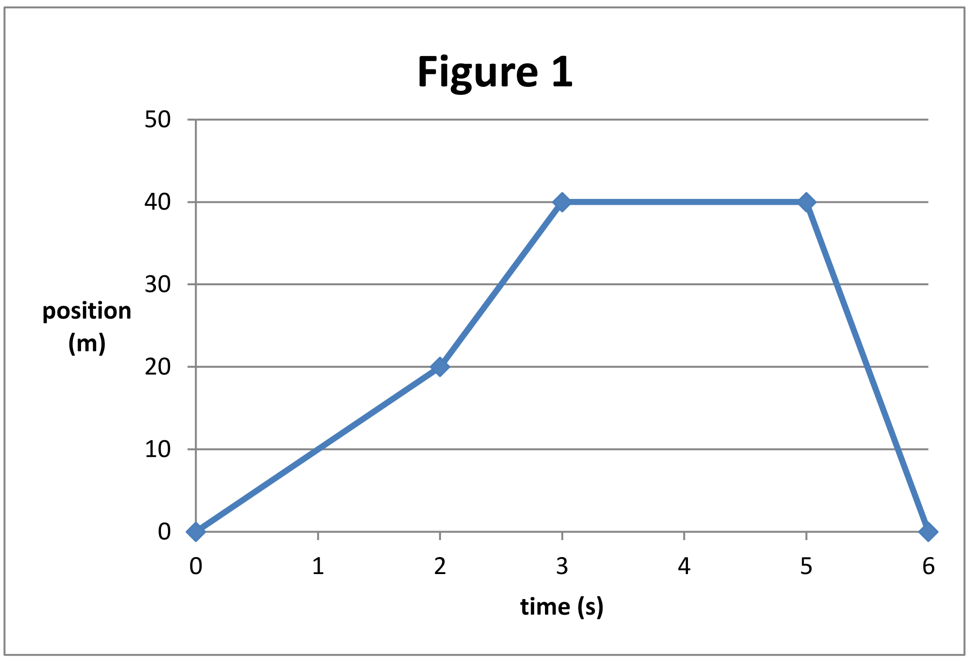
$x = x_0$

$0 = v_0 t + 1/2\, at^2$

$-1/2\, at^2 = v_0 t$

$-1/2\, at = v_0$

$t = \frac{-2v_0}{a} = \frac{(-2)(36)}{(-9.80)} = 7.35\ s$



24. In Figure 1, what is the velocity at t = 2.5 s?
    a. 0 m/s
    b. 10 m/s
    c. 20 m/s
    d. -40 m/s

Answer: C

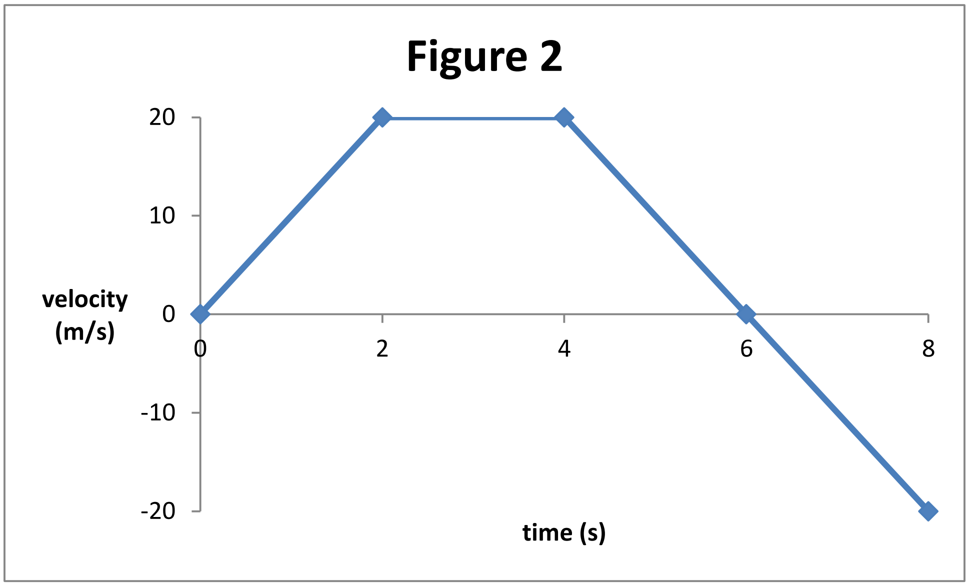
the slope of a position-time graph $\left(\frac{\Delta x}{\Delta t}\right)$ **is equal to velocity**

$\frac{40 - 20}{3 - 2} = 20m/s$

25. In Figure 1, what is the average velocity from 0 to 6.0 s?
   a. 0 m/s
   b. 10 m/s
   c. 20 m/s
   d. -40 m/s

   Answer: A

   since the position at 0 s and 6 s are both zero, the change in position is zero and thus the average velocity is zero



26. In Figure 2, what is the acceleration at 5.0 s?
   a. 0 m/s^2
   b. 10 m/s^2
   c. -10 m/s^2
   d. 20 m/s^2
   e. -20 m/s^2

   Answer: C

   the slope of a velocity-time graph $\left(\frac{\Delta v}{\Delta t}\right)$ is equal to acceleration

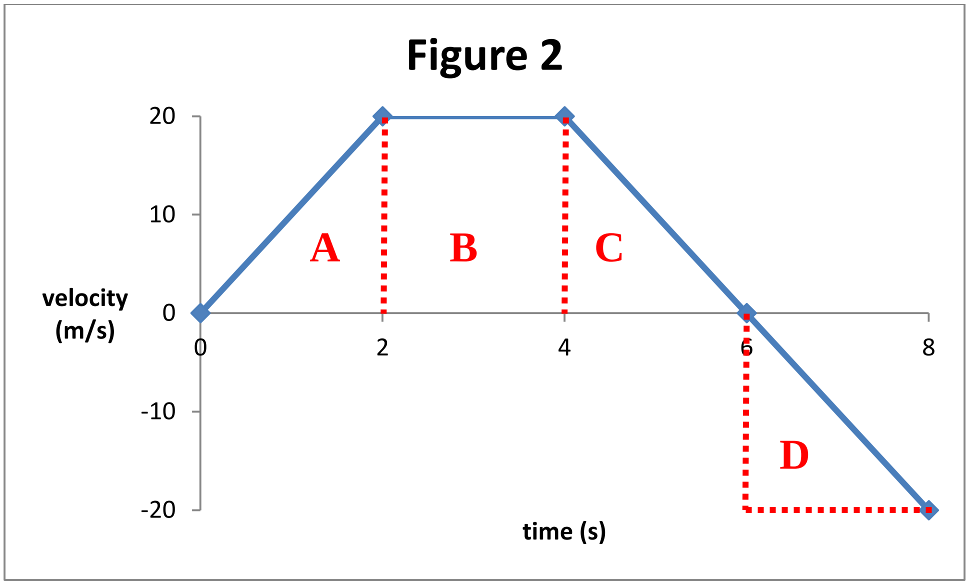
   $$\frac{0-20}{6-4} = -10m/s$$

27. In Figure 2, what is the displacement from 0 to 8.0 s?
   a. 20 m
   b. 40 m
   c. 60 m
   d. 80 m

   Answer: C

   In a velocity-time graph, displacement is equal to the area under the curve. When velocity is negative, the displacement must be subtracted because you are travelling back toward the source.

Break the diagram into sections and add/subtract the area of each section



area A = $\frac{1}{2}bh = 20$

area B = *l* x *w* = 40

area C = $\frac{1}{2}bh = 20$

area D = $\frac{1}{2}bh = 20$

Total Area = 20 + 40 + 20 - 20 = 60 m

28. A foul ball is hit straight up into the air with a speed of 30 m/s.

a. Calculate the time required for the ball to rise to its maximum height.

Answer: 3.06 s

$v = v_0 + at$, v = 0 at maximum height

$-at = v_0$

$t = \frac{v_0}{-a} = \frac{30}{-(-9.81)} = 3.06s$

b. Calculate the maximum height reached by the ball.

Answer: 45.9 m

$v^2 = v_0{}^2 + 2a(x - x_0)$, v = 0 at maximum height, x0 = 0

$-2ax = v_0{}^2$

$x = \frac{v_0{}^2}{-2a} = \frac{30^2}{-2(-9.80)} = 45.9\ m$

c. Determine the time at which the ball passes a point 25.0 m above the point of contact between the bat and ball.

Answer: 0.995 s and 5.13 s

$\mathbf{x = x_0 + v_0 t + 1/2\, at^2}$, **x0 = 0**

$\mathbf{x = v_0 t + 1/2\, at^2}$

$\mathbf{-1/2\, at^2 - v_0 t + x = 0}$

$\mathbf{-1/2\,(-9.80)t^2 - 30t + 25 = 0}$

$\mathbf{4.9t^2 + (-30)t + 25 = 0}$

$\mathbf{t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}}$

$\mathbf{t = \frac{30 \pm \sqrt{(30)^2 - 4(4.9)(25)}}{2(4.9)}}$

$\mathbf{t = \frac{30 \pm 20.2}{9.8} = 0.995, 5.13}$

d. Explain why there are two answers to part c.

Answer: the shorter time is for the ball travelling upward and the longer time is for the ball travelling back downward

29. The influence of gravity on the motion of objects is predictable under ideal conditions.

a. At what velocity would a ball have to be thrown vertically from ground level so it remains aloft for exactly 3 minutes?

Answer: 882 m/s

3 min = 180 s, 90s up and 90s down

$\mathbf{v = v_0 + at}$**, v = 0 at maximum height**

$\mathbf{-at = v_0}$

$\mathbf{v_0 = -(-9.80)(90) = 882 m/s}$

b. How could a precise stopwatch and a ball be used to measure the depth of a canyon?

Answer: Drop the ball from the top of the canyon and measure the time from release to impact at the bottom. Use the equation $\mathbf{x = x_0 + v_0 t + 1/2\, at^2}$ to calculate the height of the canyon. If you set x0 to be 0 at the top of the canyon, the acceleration due to gravity (a = g = 9.80 m/s2) will be a positive value. Since you are dropping the ball, v0 will be zero. This procedure neglects wind resistance. Stopping the timing should be based on when the ball is seen to hit the canyon floor rather than the sound because light travels faster than sound.

c. How many seconds apart should two balls be released so that a ball being dropped from a height of H reaches the ground at the same time as a ball dropped from a height of 5H?

Answer:

$y = y_0 + v_0 t + 1/2\, at^2$, $y_0 = 0$ and $v_0 = 0$, a is positive in downward direction

$y = 1/2\, at^2$

$\frac{2y}{a} = t^2$

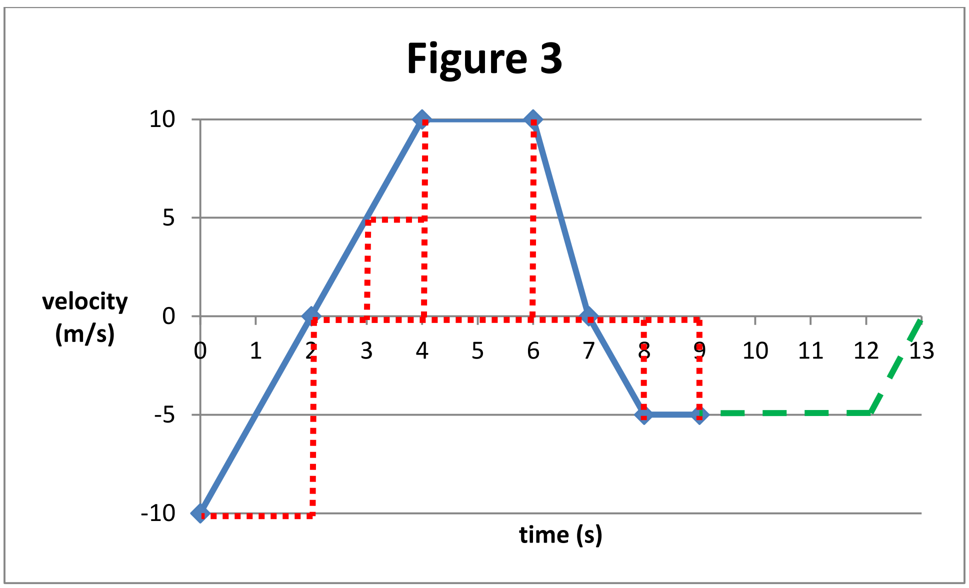
$\sqrt{\frac{2y}{a}} = t$

For y = H, $\sqrt{\frac{2H}{9.80}} = t = 0.45\sqrt{H}$

For y = 5H, $\sqrt{\frac{2(5H)}{9.80}} = t = 1.01\sqrt{H}$

The time difference would be $1.01\sqrt{H} - 0.45\sqrt{H} = 0.56\sqrt{H}$

30. Use the velocity-time graph below to answer the following questions.



a. Find the displacement between t = 0 s and t = 3 s.

Answer: -7.5 m

In a velocity-time graph, displacement is equal to the area under the curve. When velocity is negative, the displacement must be subtracted because you are travelling back toward the source. Divide the graph into sections as shown above and add the areas for the first two triangles

-10 +2.5 = -7.5 m

b. Find the displacement between t = 3 s and t = 7 s.

Answer: 32.5 m

Add the areas for the two triangles and two rectangles

2.5 +5 + 5 + 20 = 32.5 m

c. Find the displacement between t = 0 s and t = 9 s.

Answer: 17.5 m

Add your answers for a and b above, then add the areas for the triangle and rectangle from 7s to 9s.

-7.5 +32.5 - 2.5 - 5 = 17.5 m

d. Add to the velocity-time graph from t = 9 s to t = 13 s so that there is no net displacement from t = 0 to t = 13.

Answer: -17.5 m

Your sketch can be any configuration so long as the area equals -17.5. The sketch above is one of several possible. This gives -15 + (-2.5) = -17.5