Name ________Answer Key____________ Date ________________________

Honors Physics Test #2 Review

Kinematics

1. Read Chapter 2.
2. Terms to know:

   scalar, vector, magnitude, distance, displacement, average speed, instantaneous speed, average velocity, instantaneous velocity, frame of reference, relative motion, acceleration, free-fall, acceleration due to gravity.

3. How is a vector different from a scalar? Give examples of each.
   Vector needs magnitude and direction. Scalar only needs magnitude.
4. How is distance different from displacement? Give an example.
   Distance is the total path traveled. (scalar)
   Displacement is how far away you are from where you started. (vector)
5. How is speed different from velocity? Give an example.
   Speed is distance/time. (scalar)
   Velocity is displacement/time. (vector)
6. How is average speed different from instantaneous speed? Give an example.
   Average speed is for your entire trip.
   Instantaneous speed is at one particular instant of time.
7. Equations to know.
   - Constant Velocity $v = \frac{d}{t}$
   - Acceleration
     - $a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$
     - $v_{avg} = \frac{v_f + v_i}{2}$
     - $d = v_i t + \frac{1}{2}at^2$
     - $v_f = v_i + at$
     - $v_f^2 = v_i^2 + 2ad$
8. If a car goes on a trip, how can its displacement be zero but its distance is not zero?
   Displacement is zero if the car returns to its original location, while the distance is the entire path that it traveled and moved.
9. If you go for a drive in your car, how can you drive at a constant speed but not constant velocity?
   You can drive at a constant speed, of say 30 miles/hour, but if you change your direction then you are changing your velocity.
10. What is the significance of the slope of a distance or displacement vs. time graph?
    The slope gives you the speed or velocity of the object.
11. What is the significance of the slope of a speed or velocity vs. time graph?
    The slope gives you the acceleration of the object.
12. What is the significance of the area underneath a speed or velocity vs. time graph?
    The area underneath the graph gives you the distance or displacement.
13. You should be able to use the formula: $v = \frac{d}{t}$ to find the average speed, the time, or the distance for a moving object.
14. You should be able to draw distance vs. time and velocity vs. time graphs for a moving object and calculate the slope.
15. You should be able to read distance vs. time and velocity vs. time graphs as well as calculate a slope and an area underneath the graph.

16. You should be able to calculate the range, the mean, and the uncertainty in the mean of a set of data.
17. Can a car have a constant acceleration and a constant speed?
    Yes, if the car is turning with a constant speed, its direction is changing, therefore it is accelerating.
18. Can a car have a constant acceleration and a constant velocity?
    No, constant acceleration means the car is increasing its velocity at a constant rate, therefore the velocity cannot remain the same.
19. If a car is accelerating, is it changing its speed?
    Most of the time yes, acceleration is a change in speed. However, a car can accelerate by changing direction, while maintaining one speed.
20. If a car is accelerating, is it changing its velocity?
    Yes, acceleration is always a change in velocity. When turning, velocity is changing so it does not fall under the same exception as speed.
21. Can a car have a positive velocity and a negative acceleration? Is it speeding up or slowing down?
    Yes, in this instance acceleration is acting in the opposite direction of velocity, causing it to slow down.
22. Can a car have a negative acceleration and a negative velocity? Is it speeding up or slowing down?
    Yes, if the acceleration and velocity are both pointing in the same direction, which is backwards or opposite of the positive direction. In this instance the car would be speeding up in the negative direction.
23. If a car changes direction at a constant speed, is it accelerating?
    Yes, because acceleration is a vector and cares about direction
24. What are the three ways to accelerate?
    Speed up, slow down, and change direction
25. What factors affect the acceleration of a falling object with air resistance?
    Mass and shape
26. What factors affect the acceleration of a falling object without air resistance?
    Nothing.
27. Graph the displacement, distance, speed, velocity, and acceleration for an object that is dropped and one that is thrown up.
28. Is the value of "g" constant? What factors affect it?
    On Earth, yes g is a constant of 9.81 m/s². However different planets have different g.
    The acceleration due to gravity is affected by the mass of the planet and the radius of the planet.
29. What is meant by a "freely falling" object?
    An object that falls without the influence of anything except gravity is considered a freely falling object. They also start with an initial velocity of zero.

Directions: Read each question carefully and record your answers in the space provided. Be sure to show all work! Answers should be in significant figures. You will be graded on proper use of the GUESS method.
These will be the same directions on the test. Practice the GUESS method now.

30. In the Netherlands, there is an annual skating race called the "Tour of the Eleven Towns." The total distance of the course is 200. kilometers, and the record time for covering it (set in 1989) is 5.00 hours, 40.0 minutes, 37.0 seconds.

    a. Find the average speed of the record race (in m/s).

    $t = 5h, 40\min, 37s = 20437s$

    $d = 200.km = 2\times10^5 m$

    $$v = \frac{d}{t} = \frac{2.00\times10^5 m}{20437s} = 9.79 \,{}^{m}\!/_{s}$$

    b. If the first half of the distance is covered by a skater moving with a speed of 1.05***v***, where ***v*** is the average speed found in (a), how long will it take the skate the first half? Express your answer in hours and minutes.

$v = 1.05v = 1.05(9.79 \frac{m}{s})$

$d = 100.km = 1.00\times10^5 m$

$$t = \frac{d}{v} = \frac{1.00\times10^5 m}{10.3 \frac{m}{s}} = 9710s$$ **= 2 hour, 41 min, 50 seconds**

31. Tom can pedal his bike at a constant velocity of 7.2 m/s when being chased by a dog. How far can he travel in 45 seconds in order to get away?

$$d = vt = (7.2\tfrac{m}{s})(45s) = 324m = 320m$$

32. How long does it take a cross country skier to travel 650 meters, going 18.5 m/s?

$$t = \frac{d}{v} = \frac{650m}{18.5\tfrac{m}{s}} = 35s$$

33. If it takes you 45 seconds to run 340 meters, what is your average speed?

$$v = \frac{d}{t} = \frac{340m}{45s} = 7.6\,m/s$$

34. Brian Berg of Iowa built a house of cards 4.88 meters tall. Suppose Berg throws a ball from ground level straight up so that the ball just passes the top of the card house with a speed of 2.00 m/s. Calculate the initial speed of the ball.

$$v_i = \sqrt{v_f^2 - 2ad} = \sqrt{\left(2.00\tfrac{m}{s}\right)^2 - 2(-9.81\tfrac{m}{s^2})(4.88m)} = 9.99\,m/s$$

35. A soccer ball is at rest on a field. A player then kicks it horizontally for a displacement of 21.0 meters. What is the ball's final velocity after 4.00 seconds? [Hint: Two-step question.]

$$a = \frac{2d}{t^2} = \frac{2(21.0m)}{(4.00s)^2} = 2.625\tfrac{m}{s^2}$$

$$v_f = v_i + at = 2.625\tfrac{m}{s^2}(4.00s) = 10.5\,m/s$$

36. Mike bumps a volleyball straight up and catches it in the same spot as it returns to his hands. At what point in the ball's path does it experience zero velocity? If the initial velocity of the ball is 24.5 m/s upward, what is the height of the ball when the velocity is zero?
The ball experiences zero velocity at the top of the path.

$$d = \frac{v_f^2 - v_i^2}{2a} = \frac{0 - (24.5\tfrac{m}{s})^2}{2(-9.81\tfrac{m}{s^2})} = 30.6m$$

37. A coin released at rest from the top of a tower hits the ground after falling 1.5 seconds. What is the speed of the coin as it hits the ground? *[Neglect air resistance.]*

$$v_f = v_i + at = 0 + (-9.81\tfrac{m}{s^2})(1.5s) = 15\,m/s$$

38. You throw a baseball straight up and it leaves your hand at 15 meters per second. What is its velocity 2.0 seconds later? What direction is it traveling in?

$$v_f = v_i + at = 15\tfrac{m}{s} + (-9.81\tfrac{m}{s^2})(2.0s) = -4.6\tfrac{m}{s} = 4.6\tfrac{m}{s}\text{ down}$$

Directions: Read each question carefully. Select the answer that best answers the question.

39. What is the total displacement of a student who walks 3 blocks east, 2 blocks north, 1 block west and then 2 blocks south?

(A) 0 blocks (B) 2 blocks east (C) 2 blocks west (D) 8 blocks

Draw a picture. Student ends 2b east of start.

40. A sailboat on a lake sails 40. meters north and then sails 40. meters due east. Compared to its starting position, the new position of the sailboat is

(A) 40. m due east (B) 40. m due north (C) 80. m north east (D) 57 m northeast

41. A car travels 12 kilometers due north and then 8.0 kilometers due west going from town A to town B. What is the magnitude of the displacement of a helicopter that flies in a straight line from town A to town B?

(A) 14 km (B) 20. km (C) 10. km (D) 4 km

$\vec{d} = \sqrt{d_1^2 + d_2^2}$

$\vec{d} = \sqrt{(12km)^2 + (8.0km)^2}$

42. While taking off from an aircraft carrier, a jet starting from rest accelerates uniformly to a final speed of 40. meters per second on a runway that is 70. meters long. What is the magnitude of the acceleration of the jet?

(A) 0.29 m/s^2 (B) 1.8 m/s^2 (C) 11 m/s^2 (D) 0.57 m/s^2

43. The mass of a high school football player is approximately

(A) 10^3 kg (B) 10^2 kg (C) 10^1 kg (D) 10^0 kg

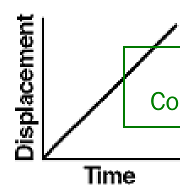
100 kg ≈ 200 lbs

44. Which term represents a scalar quantity? Magnitude only (no direction)

(A) displacement (B) force (C) weight (D) distance

45. The graph below represents the motion of an object. According to the graph, as time increases, the velocity of the object

(A) increases (B) decreases (C) Remains the same



Slope = v
Constant slope

46. A softball player leaves the batter's box, overruns first base by 3.0 meters, and then returns to first base. Compared to the total distance traveled by the player, the magnitude of the player's total displacements is

(A) Larger (B) Smaller (C) The same

Displacement = start to finish
Distance = total path

47. If a woman runs 100. meters north and then 70. meters south, her total displacement is

Displacement = start to finish

(A) 170. m north (B) 30. m north (C) 30. m south (D) 170. m south

A runner completed the 100.-meter dash in 10.0 seconds. Her average speed was

(A) 0.100 m/s (B) 100. m/s (C) 10.0 m/s (D) 1,000. m/s

$v = \frac{d}{t} = \frac{100.m}{10.0s}$

48. Which two terms represent a vector quantity and the scalar quantity of the vector's magnitude, respectively?

(A) acceleration and velocity
(B) weight and force
(C) displacement and distance
(D) speed and time

Displacement = start to finish
Distance = total path

49. In an experiment that measures how fast a student reacts, a meter stick dropped from rest falls 0.20 meter before the student catches it. The reaction time of the student is approximately

(A) 0.10 s (B) 0.20 s (C) 0.40 s (D) 0.30 s

$t = \sqrt{\frac{2d}{a}} = \sqrt{\frac{2(0.20m)}{9.81\frac{m}{s^2}}}$

50. A bicyclist accelerates from rest to a speed of 5.0 meters per second in 10. seconds. During the same 10. seconds a car accelerates from a speed of 22 meters per second to a speed of 27 meters per second. Compared to the acceleration of the bicycle, the acceleration of the car is

(A) The same (B) less (C) greater

$a_{bike} = \frac{\Delta v}{t} = \frac{5.0\frac{m}{s} - 0\frac{m}{s}}{10.s} = 0.50\frac{m}{s^2}$ $a_{car} = \frac{\Delta v}{t} = \frac{27\frac{m}{s} - 22\frac{m}{s}}{10.s} = 0.50\frac{m}{s^2}$

51. Two cars, A and B, are 400. meters apart. Car A travels due east at 30. meters per second on a collision course with car B, which travels due west at 20. meters per second. How much time elapses before the two cars collide?

(A) 40. s (B) 20. s (C) 13 s (D) 8.0 s

$v_{rel} = v_A - v_B = 30.\frac{m}{s} - (-20.\frac{m}{s}) = 50.\frac{m}{s}$

$t = \frac{d}{v} = \frac{400.m}{50.\frac{m}{s}}$

52. A ball is thrown straight up with a speed of 12 meters per second near the surface of the Earth. What is the maximum height reached by the ball? *[Neglect air resistance].*

(A) 1.2 m (B) 0.37 m (C) 15 m (D) 7.3 m

$d = \frac{-v_i^2}{2d} = \frac{-(12\frac{m}{s})^2}{2(-9.81\frac{m}{s^2})}$

53. A boat initially traveling at 10. meters per second accelerates uniformly at the rate of 5.0 meters per second^2 for 10. seconds. How far does the boat travel during this time?

(A) 350 m (B) 50. m (C) 250 m (D) 500 m

$d = v_i t + \frac{1}{2}at^2$

$d = (10.\frac{m}{s})(10.s) + \frac{1}{2}(5.0\frac{m}{s^2})(10.s)^2$

54. A runner starts from rest and accelerates uniformly to a speed of 8.0 meters per second in 4.0 seconds. The magnitude of the acceleration of the runner is

(A) 0.50 m/s^2 (B) 2.0 m/s^2 (C) 9.8 m/s^2 (D) 32 m/s^2

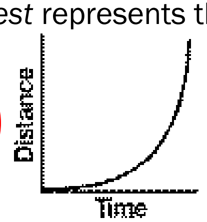
$a = \frac{\Delta v}{t} = \frac{8.0\frac{m}{s} - 0\frac{m}{s}}{4.0s}$

55. A 1,000 kg car traveling with a velocity of + 20. meters per second decelerates uniformly at -5.0 meters per second^2 unit it comes to rest. What is the total distance the car travels as it decelerates to rest?

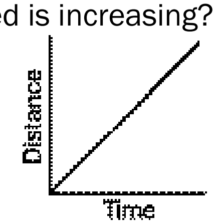
(A) 20. m (B) 80. m (C) 40. m (D) 10. m

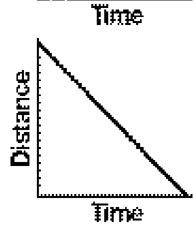
$d = \frac{-v_i^2}{2d} = \frac{-(20.\frac{m}{s})^2}{2(-5.0\frac{m}{s^2})}$

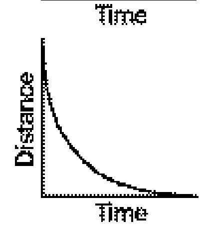
56. Which graph *best* represents the motion of an object whose speed is increasing?

A)


Slope = v
Increasing slope

C)


B)


D)


57. A football player starts from rest 20 meters from the goal line and accelerates away from the goal line at 2 m/s^2. How far from the goal line is the player after 4 s?

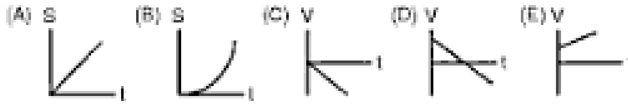
(A) 8 m (B) 28 m (C) 32 m (D) 36 m (E) 52 m

$d = v_i t + \frac{1}{2}at^2$

$d = \frac{1}{2}(2\frac{m}{s^2})(4s)^2 = 16m$

$16m + 20m = 36m$

Questions 59 through 61 refer to the following graphs:



58. In which of the graphs is the velocity of the moving object constant?

Position time is linear

(A) A (B) B (C) C (D) D (E) E

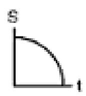
59. In which of the graphs does the moving object reverse its direction?

Velocity-time crosses over the axis

(A) A (B) B (C) C (D) D (E) E

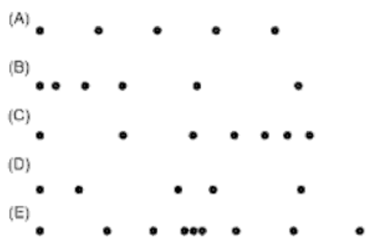
60. Which of the graphs is equivalent to the displacement vs. time graph below?

Negative direction – getting faster



(A) A (B) B (C) C (D) D (E) E

Questions 62 through 65 refer to the following series of images of a moving ball. Each image represents a time interval of one second, and the motion of the ball is not necessarily horizontal.



61. In which of the choices above is the ball increasing its speed?

Dots spread out

(A) A (B) B (C) C (D) D (E) E

62. In which of the choices above is the ball moving at a constant velocity?

Uniformly spaced dots

(A) A (B) B (C) C (D) D (E) E

63. Which of the choices above could represent the ball being thrown upward before it begins falling back down?

Dots closer together – slowing down

(A) A (B) B (C) C (D) D (E) E

64. Which of the choices above could represent the ball being rolled up an incline and then allowed to roll back down again?

Slower then faster

(A) A (B) B (C) C (D) D (E) E

65. The graph below shows velocity *v* as a function of time *t* for a particle moving in a straight line. Graphs of displacement *s* versus time *t* that are consistent with the *v* vs. *t* graph above include which of the following?

Slope = velocity

(A) I only (B) III only (C) II and III only (D) I, II, and III (E) I and II only

66. A stone is dropped from rest. What is the acceleration of the stone immediately after it is dropped? Gravity

(A) zero (B) 5 m/s² (C) 10 m/s² (D) 20 m/s² (E) 30 m/s²

Questions 68 through 70 relate to a ball thrown straight up, reaching its maximum height in 3 s.

67. The initial velocity of the ball is most nearly

$v_i = v_f - at$
$v_i = -(-10\,\frac{m}{s^2})(3s)$

(A) 10 m/s (B) 15 m/s (C) 30 m/s (D) 45 m/s (E) 60 m/s

68. The magnitude of the acceleration of the ball at the instant it reaches its maximum height is most nearly Gravity

(A) Zero (B) 5 m/s² (C) 10 m/s² (D) 12 m/s² (E) 20 m/s²

69. The maximum height of the ball is most nearly

$$d = \frac{v_f^2 - v_i^2}{2a} = \frac{-(30\,\frac{m}{s})^2}{2(-10\,\frac{m}{s^2})}$$

(A) 10 m (B) 15 m (C) 30 m (D) 45 m (E) 60 m

Questions 71 through 72 relate to an object which starts with a speed of 10 m/s and accelerates at -2 m/s².

70. How much time will pass until it comes to rest?

$$t = \frac{v_f - v_i}{a} = \frac{-10\,\frac{m}{s}}{-2\,\frac{m}{s^2}}$$

(A) 2 s (B) 4 s (C) 5 s (D) 12 s (E) 20 s

71. How far does the object travel before coming to rest?

$$d = \frac{v_f^2 - v_i^2}{2a} = \frac{-(10\,\frac{m}{s})^2}{2(-2\,\frac{m}{s^2})}$$

(A) 10 m (B) 25 m (C) 50 m (D) 75 m (E) 100 m

Answers:

30.
a. 9.80 m/s
b. 2h, 41m, 50s
31. 320 m
32. 35 s
33. 7.6 m/s
34. 9.99 m/s
35. 10.5 m/s
36. v = zero at top
d = 30.6 m
37. 15 m/s
38. 4.6 m/s
Downward

39. B
40. D
41. A
42. C
43. B
44. D
45. C
46. B
47. B
48. C
49. C
50. B
51. A
52. D
53. D
54. A
55. B
56. C
57. A
58. D
59. A
60. D
61. C
62. B
63. A
64. C
65. E
66. E
67. C
68. C
69. C
70. D
71. C
72. B