Honors Physics: 1st Semester Exam
Review Questions

The focus of the exam is breadth of material more so than depth. However, take the time to carefully review the main emphasis of each chapter.

Mathematical Toolkit

Ideas:

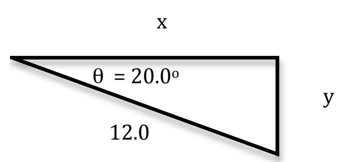
1. What are the two kinds of vector representations? What information is given in each kind?
2. What are the differences between vectors and scalars? (Think of some examples of each)
3. Adding by components, what vector representation do vectors need to be in, why?

How many significant figures are in each number?

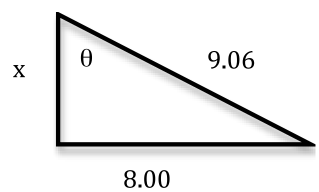
4. ________ 210
5. ________ 2.100
6. ________ 0.008750

Find any missing values for the triangles below.

7.



8.

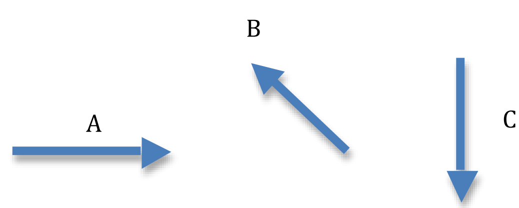


Change the following coordinates from polar coordinates to rectangular or vice-versa

9. (6.00, -3.00)
10. (5.34, 110°)

Based on the vectors (A, B, and C) given to the right, sketch the following combinations.

11. A + B
12. B + 2C – A



Adding by Components

13. Find the sum (in rectangular coordinates) for Vector A + Vector B
    Vector A (2.08, 56.0°)
    Vector B (4.00, 270.0°)

Kinematics in One-Dimension

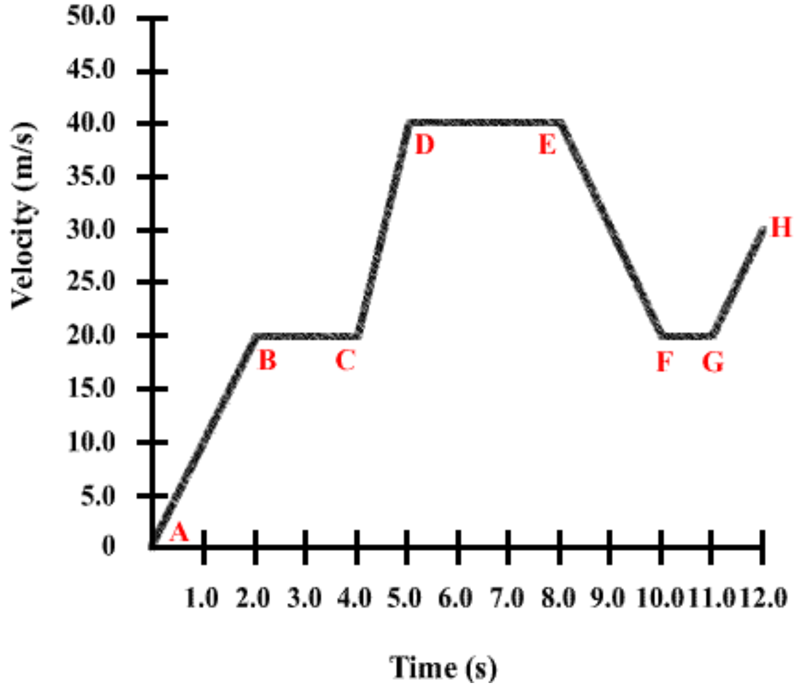
Ideas

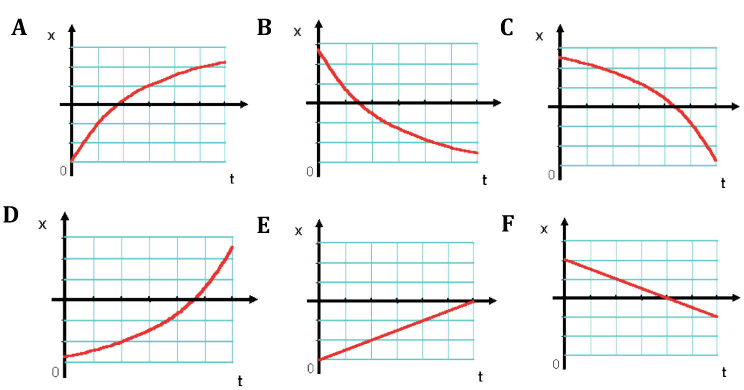
14. What is the difference between speed and velocity, distance and displacement?
15. *What information can be gained by graphical analysis? (Look back at the snowman)
16. What does concavity on a position graph tell you?
17. Velocity/Acceleration Combinations. Specifically, what motion is produced if you have negative velocity, positive acceleration or negative velocity, negative acceleration?

Graphical Analysis 1

Use the ***Velocity vs. Time*** *graph to the right to answer questions 18 – 20*

18. In which segment(s) is the velocity constant?
19. In which segment(s) does the object have a negative acceleration?
20. In which segment(s) is the acceleration the same?





Graphical Analysis 2

Using the Position vs. Time graphs (A through F) to the left to answer questions 21 - 23

21. Which graph(s) show constant velocity, no acceleration?
22. Which graph(s) show a positive acceleration?
23. Which graph(s) show a positive velocity, but negative acceleration?

Kinematics

24. A car slows from a velocity of 23.0 m/s to a stop in 89.0 m. What was the car's acceleration?
25. A ball is thrown upwards with an initial velocity of 25.0 m/s. How long will it take for the ball to reach the highest point of its motion? What values go to zero at the highest point?
26. Some crazy kids were throwing water balloons from the top of the school (approx. 6.10 m) down on top of other students as they were coming in for class. The balloons hit the ground below after 0.60 s. With what initial downward velocity were the water balloons thrown?

Kinematics in Two Dimensions (Projectile Motion)

Ideas

27. One ball is dropped and the other thrown horizontally outwards with an initial velocity, but if they begin at the same height, which will hit the ground first?
28. What things can be assumed in projectile motion?
29. How is a ½ projectile different from a full projectile?
30. What happens to the velocity of a projectile at the highest point of its motion?
31. What can be assumed if a full projectile is perfectly symmetric?

½ Projectiles

32. A stone is thrown horizontally with a velocity of 5.00 m/s from the top of a cliff that is 78.4 m high.
    A. How long does it take the stone to reach the bottom of the cliff?
    B. How far from the base of the cliff does the stone hit the ground?

33. A movie stunt driver speeds horizontally off a 50.0 m tall cliff. The car lands 90.0 m horizontally from the base of the cliff.
    A. What was the initial velocity of the car? (Consider, what kind or kinds of velocity does a ½ projectile initially have?)
    B. Halfway down to the bottom of the cliff, what was the velocity in the x-direction, velocity in the y-direction, and the magnitude of the resultant velocity?

Full Projectile

34. A football is kicked with an initial velocity (v_o) of 23.5 m/s at an angle of 66.0^o above the horizontal. Find the following:
    A. The initial x- and y-velocities
    B. The maximum height
    C. The hang time or time of flight
    D. The range
    E. At the moment of impact, the velocity in the x-direction, velocity in the y-direction, the magnitude of the final velocity.

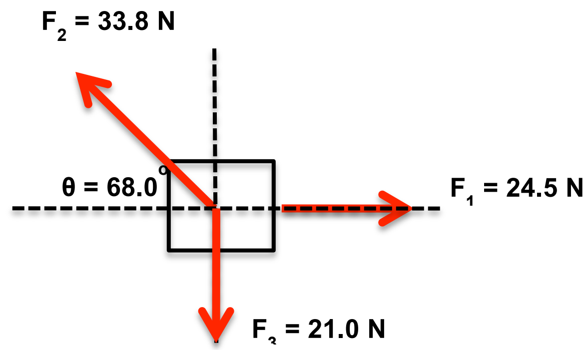
Forces and Newton's Three Laws of Motion:

Ideas

35. What is inertia?
36. What are Newton's Three Laws of Motion?
37. What is the difference between equilibrium and non-equilibrium? How can an object be in equilibrium?
38. What is the difference between mass and weight?
39. How might an object transition between static friction, maximum static friction, and kinetic friction?

Forces:

40. Calculate the ΣF_x and ΣF_y for the object to the right.



41. A child is playing with a matchbox car (mass = 0.200 kg) on a flat, frictionless track. The car is already moving with an initial velocity of 10.0 m/s. The child gives the car a push, accelerating the car to a velocity of 13.0 m/s over the distance of 6.00 m.
    A. What is the acceleration of the car?
    B. How much force did the child give to the car?

42. A little boy is pulling on a toy train that drags behind him at a **constant velocity.** The mass of the toy is 6.50 kg and the boy is pulling with a force of 44.0 N directed at 33.0° above the horizontal.
    Equilibrium or Non-equilibrium ΣF_x: ________________
    Equilibrium or Non-equilibrium ΣF_y: ________________
    A. What is the normal force?
    B. What is the coefficient of kinetic friction?

43. A 72.0 kg box slides down a 25.0° ramp. The coefficient of kinetic friction is 0.0610.
    Equilibrium or Non-equilibrium ΣF_x: ________________
    Equilibrium or Non-equilibrium ΣF_y: ________________
    A. Write a statement for ΣF_x and ΣF_y
    B. What are the components of the force of gravity?
    C. What is the value of the normal force?
    D. What is the acceleration of the box?

Work, Power, and Energy

Ideas

44. What does work tell us about a force?
45. What does power tell us about a force?
46. In what scenario is work positive? In what scenario is it negative? Or zero?
47. What is the difference between kinetic energy and gravitational potential energy?
48. What does it mean that energy is conserved?

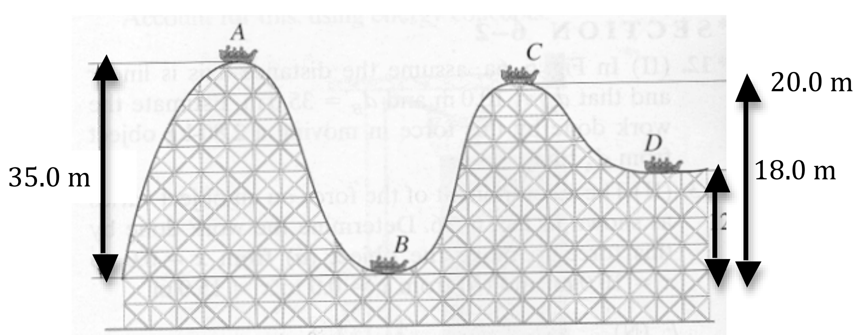
Work, Power, and Energy

49. You are dragging a 50.0 kg crate across the floor using a constant force of 100. N. Your force is directed up at an angle of 42.0° above the horizontal and moves the crate 40.0 m horizontally. Unfortunately, the floor is a rough surface that exerts of force of 52.0 N to oppose the crate.
    A. Calculate the work done by your force.
    B. Calculate the work done by friction
    C. Calculate the work done by gravity
    D. Calculate the work done by the normal force
    E. Calculate the net or total work done on the system.

50. How much time will it take a motor with 1750 W of power to lift a 285 kg piano with a constant velocity up to a sixth story window, 16.0 m above the ground?

51. Two athletes push a 75.0 kg bobsled along a horizontal surface. After the bobsled is pushed by their horizontal force through a distance of 4.50 m, starting from rest, the bobsled's velocity is 6.00 m/s. Friction is negligible. What is the value of the net force the two athletes exert on the bobsled?

52. A roller coaster is pulled up to a point where it and its screaming occupants are released from rest at point A. Assuming energy is conserved, calculate the velocity of the roller coaster at point C and D.



Impulse, Momentum, and Collisions

Ideas

53. If we want to change the momentum of an object, what is needed?
54. How can the Impulse-Momentum Theory be used to explain why we 'tuck and roll' when falling a significant distance?
55. What is the difference between an internal and an external force in reference to a closed system?
56. What does the conservation of momentum tell us?
57. What are the three kinds of collisions we studied? What is conserved in each?

Impulse-Momentum Theory

58. A soccer player accelerates a 0.55 kg soccer ball from a velocity of 4.30 m/s to a velocity of 16.7 m/s in a time of 0.25 s.
    A. What is the change of momentum of the soccer ball?
    B. What is the force given to the soccer ball?

59. A 1.50 kg rock is dropped from a height of 7.00 m above the ground.
    A. What is the velocity of the rock just before it hits the ground?
    B. What will be the rock's change in momentum as it comes to a stop on the ground?

Collisions

60. A 9.50 x 10^3 kg boxcar is initially traveling 16.0 m/s when it collides with another boxcar that was initially stationary. The two move off together with a velocity of 6.00 m/s.
    A. What kind of collision has occurred?
    B. What is the mass of the second boxcar?

61. A 0.0150 kg coin moving to the right at 0.225 m/s makes an elastic collision with a 0.0300 kg coin moving to the left at 0.180 m/s. After the collision, the 0.0150 kg coin moves to the left with a velocity of 0.315 m/s. What is the final velocity of the 0.0300 kg coin? Verify that this was an elastic collision by solving the problem two ways (using conservation of momentum AND conservation of kinetic energy).

Numerical Answers:

Mathematical Toolkit

4. Sig Figs = 2
5. Sig Figs = 4
6. Sig Figs = 4

7. x = 11.3
   y = 4.10
8. x = 4.25
   $\theta = 62.0^{o}$

9. (6.00, -3.00) → (6.71, -26.6^{o})
10. (5.34, 110^{o}) → (-1.83, 5.02)

13. Resultant (1.16, -2.28)

Kinematics in One-Dimension

18. Segments BC, DE, and FG
19. Segment EF
20. BC, DE, and FG have an acceleration of 0 m/s^2, Segments AB and GH have an acceleration of 10 m/s^2

21. No concavity, Graphs E and F
22. Concave up, Graphs B and D
23. Upward trend, but concave down, Graph A

24. a = - 2.97 m/s^2
25. t = 2.55 s
26. v_o = -7.22 m/s

Kinematics in Two-Dimensions

32. A.) t = 4.00 s
    B.) x = 20.0 m
33. A.)There is no initial velocity in the y-direction, v_x = 28.2 m/s
    B.) v_x = 28.2 m/s, v_{fy} = -22.1 m/s, and v_f = 35.8 m/s

34. A.) v_x = 9.56 m/s and v_{oy} = 21.5 m/s
    B.) y_{max} = 23.6 m
    C.) t = 4.39 s
    D.) x = 42.0 m
    E.) (Symmetric) v_x = 9.56 m/s, v_{fy} = -21.5 m/s and v_f = 23.5 m/s

Force and Newton's Three Laws of Motion

40. ΣF_x = 11.8 N and ΣF_y = 10.3 N
41. A.) a = 5.75 m/s^2
    B.) F = 1.15 N
42. ΣF_x = Equilibrium ΣF_y = Equilibrium
    A.) F_N = 39.7 N
    B.) μ_k = 0.93
43. ΣF_x = Non-Equilibrium
    ΣF_y = Equilibrium
    A.) $\Sigma F_x = F_{gx} - F_{fk}$
    $\Sigma F_x = F_N - F_{gy}$
    B.) F_{gx} = 298 N F_{gy} = 639 N
    C.) F_N = 639 N
    D.) a = 3.57 m/s^2

Work, Power, and Energy

49. A.) W ≈ 2970 J
    B.) W = -2080 J
    C.) W = 0 J
    D.) W = 0J
    E.) W_{net} ≈ 890 J
50. t = 25.5 s
51. F_{net} = 300 N
52. Velocity at Point C = 17.1 m/s
    Velocity at Point D = 18.3 m/s

Impulse, Momentum, and Collisions

58. A.) $\Delta p = 6.82\ kg \cdot \frac{m}{s}$
    B.) F = 27.3 N
59. A.) v_f = -11.7 m/s
    B.) $\Delta p = 17.6\ kg \cdot \frac{m}{s}$
60. A.) Total Inelastic Collision
    B.) m_2 = 15,833 kg ≈ 15,800 kg
61. v_f = 0.090 m/s