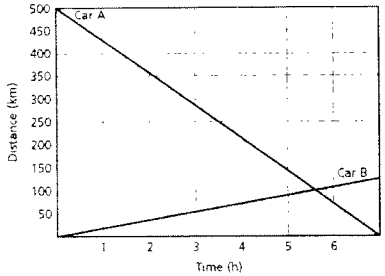
Name: _____ Class: _____ Date: _____ ID: A

Study Guide for Fall Final Physics 1011

Problem

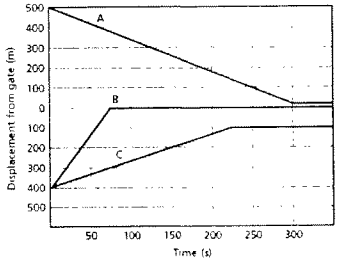
1. Calculate the following and express the result with the correct number of significant digits and correct units.
   a. 4.000 m × 20.30 m
2. On Earth, the force of gravity on an object is expressed as $F = m \times g$, where F is the force applied on the object, m is the mass of the object, and g is the gravitational constant, which is 9.80 m/s^2.
   a. What are the units of the force of gravity if the mass is expressed in kilograms?
   b. Calculate the gravitational force on an object with a mass of 10.32 kg.
3. State the number of significant digits in each of the following measurements
   a. 903 kg
   b. 600.00 m
   c. 0.0030 mm
   d. 8.030310 ^{4} J
4. An airplane travels at a constant speed, relative to the ground, of 900.0 km/h.
   a. How far has the airplane traveled after 2.0 h in the air?
   b. How long does it take for the airplane to travel between City A and City B if the cities are 3240 km apart?
5. The graph below shows the distance versus time for two cars traveling on a straight highway.



   a. What can you determine about the relative direction of travel of the cars?
   b. At what time do they pass one another?
   c. Which car is traveling faster? Explain.
   d. What is the speed of the slower car?
6. You drop a ball from a height of 2.0 m. It falls to the floor, bounces straight upward 1.3 m, falls to the floor again, and bounces 0.7 m.
   a. Use vector arrows to show the motion of the ball.
   b. At the top of the second bounce, what is the total distance that the ball has traveled?
   c. At the top of the second bounce, what is the ball's displacement from its starting point?
   d. At the top of the second bounce, what is the ball's displacement from the floor?

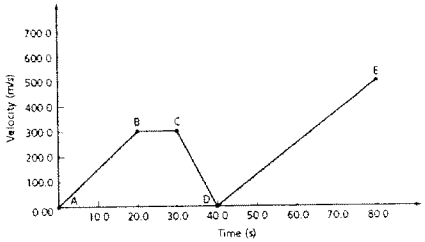
Name: _____ ID: A

7. You are making a map of some of your favorite locations in town. The streets run north–south and east–west and the blocks are exactly 200 m long. As you map the locations, you walk three blocks north, four blocks east, one block north, one block west, and four blocks south.
   a. Draw a diagram to show your route.
   b. What is the total distance that you traveled while making the map?
   c. Use your diagram to determine your final displacement from your starting point.
   d. What vector will you follow to return to your starting point?
8. The position-time graph below represents the motion of three people in an airport moving toward the same departure gate.



   a. Which person travels the farthest during the period shown?
   b. Which person travels fastest by riding a motorized cart? How can you tell?
   c. Which person starts closest to the departure gate?
   d. Which person appears to be going to the wrong gate?
9. A radio signal takes 1.28 s to travel from a transmitter on the Moon to the surface of Earth. The radio waves travel at 3.00×10^8 m/s. What is the distance, in kilometers, from the Moon to Earth?

10. Use the velocity-time graph below to calculate the velocity of the object whose motion is plotted on the graph.



a. What is the acceleration between the points on the graph labeled A and B?
b. What is the acceleration between the points on the graph labeled B and C?
c. What is the acceleration between the points on the graph labeled D and E?
d. What is the total distance that the object travels between points B and C?

11. If you throw a ball straight upward, it will rise into the air and then fall back down toward the ground. Imagine that you throw the ball with an initial velocity of 13.7 m/s.
a. How long does it take the ball to reach the top of its motion?
b. How far will the ball rise before it begins to fall?
c. What is its average velocity during this period?

12. A car is traveling at 20 m/s when the driver sees a ball roll into the street. From the time the driver applies the brakes, it takes 2 s for the car to come to a stop.
a. What is the average acceleration of the car during that period?
b. How far does the car travel while the brakes are being applied?

13. A hot air balloon is rising at a constant speed of 1.00 m/s. The pilot accidentally drops his pen 10.0 s into the flight.
a. How far does the pen drop?
b. How fast is the pen traveling when it hits the ground, ignoring air resistance?

14. During a serve, a tennis ball leaves a racket at 180 km/h after being accelerated for 80.0 ms.
a. What is the average acceleration on the ball during the serve in m/s^2?
b. How far does the ball move during the period of acceleration?

15. Anna walks off the end of a 10.0-m diving platform.
a. What is her acceleration in m/s^2 toward the pool?
b. How long does it take her to reach the water?
c. What is her velocity when she reaches the water?

16. The table below shows the velocity of a student walking down the hallway between classes.

Time (s)	Velocity (m/s)
0.0	0.0
10.0	1.5
20.0	1.5
30.0	1.5
31.0	0.0
40.0	0.0
50.0	3.0
60.0	3.0
61.0	0.0

a. What is happening to the student's speed during $t = 60.0$ s and $t = 61.0$ s?
b. What is his acceleration between $t = 10.0$ s and $t = 20.0$ s?
c. What is his acceleration between $t = 60.0$ s and $t = 61.0$ s?
d. Assuming constant acceleration, how far did he walk during the first 5 s?

17. A sky diver jumps from an airplane 1000.0 m above the ground. He waits for 8.0 s and then opens his parachute. How far above the ground is the sky diver when he opens his parachute?

18. You and your bike have a combined mass of 80 kg. How much braking force has to be applied to slow you from a velocity of 5 m/s to a complete stop in 2 s?

19. A golfer uses a club to hit a 45-g golf ball resting on an elevated tee, so that the golf ball leaves the tee at a horizontal speed of +38 m/s.
a. What is the impulse on the golf ball?
b. What is the average force that the club exerts on the golf ball if they are in contact for 2.0×10^{-3} s?
c. What average force does the golf ball exert on the club during this time interval?

20. A 0.0420-kg hollow racquetball with an initial speed of 12.0 m/s collides with a backboard. It rebounds with a speed of 6.0 m/s.
a. Calculate the total impulse on the ball.
b. If the contact time lasts for 0.040 s, calculate the average force on the ball.

21. A tennis player receives a shot with the 60.0-g ball traveling horizontally at –50.0 m/s, and returns the shot with the ball traveling horizontally. The tennis ball and the tennis racket are in contact for 1.00×10^{-3} s. The average force exerted on the ball by the tennis racket is 5.70×10^{3} N. Find the speed of the tennis ball after it leaves the racket.

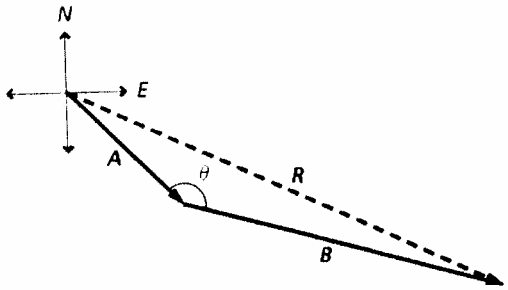
22. A single uranium atom has a mass of 3.97×10^{-25} kg. It decays into the nucleus of a thorium atom by emitting an alpha particle at a speed of 2.10×10^{7} m/s. The mass of an alpha particle is 6.68×10^{-27} kg. What is the recoil speed of the thorium nucleus?

23. A 10.0-g bullet is fired into a stationary 5.00-kg block of wood. The bullet lodges inside the block. The speed of the block-plus-bullet system immediately after the collision is measured as 0.600 m/s. What was the original speed of the bullet?

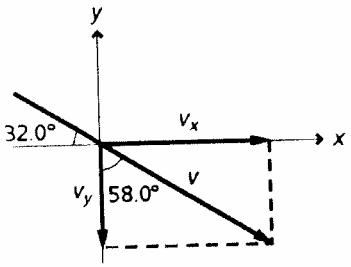
24. Aisha is sitting on frictionless ice and holding two heavy ski boots. Aisha weighs 637 N, and each boot has a mass of 4.50 kg. Aisha throws both boots forward at the same time, at a velocity of 6.00 m/s relative to her. What is Aisha's resulting velocity?

roblem

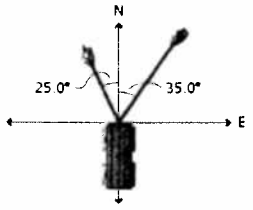
1. A small plane takes off and flies 12.0 km in a direction southeast of the airport. At this point, following the instructions of an air traffic controller, the plane turns 20.0° to the east of its original flight path and flies 21.0 km. What is the magnitude of the plane's resultant displacement from the airport?



2. A hammer slides down a roof that makes a 32.0° angle with the horizontal. What are the magnitudes of the components of the hammer's velocity at the edge of the roof if it is moving at a speed of 6.25 m/s?



3. To get a cart to move, two farmers pull on ropes attached to the cart, as shown below. One farmer pulls with a force of 50.0 N in a direction 35.0° east of north, while the other exerts a force of 30.0 N in a direction 25.0° west of north. What are the magnitude and the direction of the combined force exerted on the cart?



Study Guide for Fall Final Physics 1011
Answer Section

PROBLEM

1. ANS:
   a. = 7.0×10^{1} m or 70.3 m
   b. = 6.0×10^{-1} km/s or 0.6 km/s
   c. = 8.120×10^{2} m^2 or 81.20 m^2
   d. = 0.55 mm + 0.0020 mm
   = 0.55 mm or 5.5×10^{-1} mm

   PTS: 1
2. ANS:
   a. $F = m \times g$
   $= F$ = kg 9.80 m/s^2
   Therefore, the units are kg·m/s^2
   b. $F = m \times g$
   = 10.32 kg × 9.80 m/s^2
   = 101 kg·m/s^2

   PTS: 1
3. ANS
   a. 3; 9.03×10^{2} kg
   b. 5; 6.0000×10^{2} m
   c. 2; 3.0×10^{-3} mm
   d. 4; 8.030×10^{-4} J
   e. 4; 3.860×10^{-2} m/s

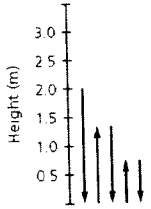
   PTS: 1

4. ANS:
   a. $d = vt$
   $= (900.0\text{ km/h})(2.0\text{ h})$
   $= 1800\text{ km}$
   b. $t = \dfrac{d}{v}$
   $= \dfrac{3240\text{ km}}{900.0\text{ km/h}}$
   $= 3.600\text{ h}$
   c. $t = \dfrac{d}{v}$
   $= \dfrac{3240\text{ km}}{1200\text{ km/h}}$
   $= 2.7\text{ h}$
   The second plane arrives 3.7 h after the first plane departs, so the first plane arrives before the second.

   PTS: 1
5. ANS:
   a. The cars are traveling in opposite directions.
   b. They pass 5 h after starting.
   c. Car A is traveling faster because the slope of its line has a larger magnitude. The slope represents $\dfrac{\Delta d}{\Delta t}$, or speed.
   d. The speed is equal to the slope of the line $\dfrac{\Delta d}{\Delta t}$, which is calculated from two points on the graph as 20 km/h.

   PTS: 1

6. ANS:
a.



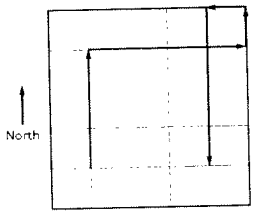
b. $d = d_1 + d_2 + d_3 + d_4$
$= 2.0\text{ m} + 1.3\text{ m} + 1.3\text{ m} + 0.7\text{ m}$
$= 5.3\text{ m}$

c. $\Delta d = d_1 + (-d_2) + d_3 + (-d_4)$
$= 2.0\text{ m} - 1.3\text{ m} + 1.3\text{ m} - 0.7\text{ m}$
$= 1.3\text{ m}$ downward

d. 0.7 m upward

PTS: 1

7. ANS:
a.



b. $d_{total} = d_1 + d_2 + d_3 + d_4 + d_5$
$= 3\text{ blocks} + 4\text{ blocks} + 1\text{ block} + 1\text{ block} + 4\text{ blocks} = 13\text{ blocks}$
$13\text{ blocks} \times 200\text{ m/block} = 2600\text{ m}$
c. $3\text{ blocks} \times 200\text{ m/block} = 600\text{ m}$
The displacement is 600 m east from the starting point.
d. 600 m toward the west.

PTS: 1

8. ANS:
a. person A
b. person B. The magnitude of the slope is largest for line B when the person is traveling.
c. Person B and person C start 400 m from the gate.
d. person C

PTS: 1

9. ANS:
$d = vt$

$= \left(3.00 \times 10^8\text{ m/s}\right) \times 1.28\text{ s}$

$= 3.84 \times 10^8\text{ m}$

$= \left(3.84 \times 10^8\text{ m}\right) \times \left(\frac{1\text{ km}}{1000\text{ m}}\right)$

$= 3.84 \times 10^5\text{ km}$

PTS: 1

10. ANS:
a. $\frac{\Delta v}{t} = \frac{\left(v_f - v_i\right)}{t}$

$= \frac{300.0\text{ m/s} - 0.0\text{ m/s}}{}$

$= 15.0\text{ m/s}^2$

b. $\Delta v = 0$, therefore $a = 0$
(no acceleration)
c. $a = \frac{\Delta v}{t} = \frac{\left(v_f - v_i\right)}{t}$

$= \frac{0.0\text{ m/s} - 500.0\text{ m/s}}{}$

$= -125\text{ m/s}^2$

d. $d = vt$
$= 300.0\text{ m/s} \times 10.0\text{ s}$
$= 3.00 \times 10^3\text{ m}$

PTS: 1

11. ANS:

a. $v_f = v_i + at$

therefore $t_f = \dfrac{v_f - v_i}{a}$

$t = \dfrac{13.7\text{ m/s} - 0.00\text{ m/s}}{}$

$= 1.40\text{ s}$

b. $d = \dfrac{1}{2}(v_f + v_i)t$

$= \dfrac{1}{2}(13.7\text{ m/s} + 0.00\text{ m/s})(1.40\text{ s})$

$= 9.59\text{ m}$

c. $v_{ave} = \dfrac{d_f - d_i}{t}$

$= \dfrac{9.59\text{ m} - 0.00\text{ m}}{1.40\text{ s}}$

$= 6.85\text{ m/s}$

PTS: 1

12. ANS:

a. $a = \dfrac{\Delta v}{t} = \dfrac{v_f - v_i}{t}$

$= \dfrac{0\text{ m/s} - 20\text{ m/s}}{2\text{ s}}$

$= -10\text{ m/s}^2$

b. $d = d_i + v_i t + \dfrac{1}{2}at^2$

$= 0\text{ m} + (20\text{ m/s})(2\text{ s}) + \dfrac{1}{2}\left(-10\text{ m/s}^2\right)(2\text{ s})^2$

$= 0\text{ m} + 40\text{ m} + (-20\text{ m/s})$

$= 20\text{ m}$

PTS: 1

13. ANS:

a. The pen falls from the altitude of the balloon at 10 s.

$d = vt$

$= (1.00\text{ m/s})(10.0\text{ s})$

$= 10.0\text{ m}$

b. $v_f^2 = v_i^2 + 2a(d_f - d_i)$

$= 0 + 2(9.80\text{ m/s}^2)(10.0\text{ m} - 0.00\text{ m})$

$= 196\text{ m}^2/\text{s}^2$

$v = 14.0\text{ m/s}$

PTS: 1

14. ANS:

a. $vf = (180\text{ km/h})\left(\dfrac{1000\text{ m}}{1\text{ km}}\right)\left(\dfrac{1\text{ h}}{3600\text{ s}}\right)$

$= 5.0 \times 10^1\text{ m/s}$

$a = \dfrac{\Delta v}{t} = \dfrac{v_f - v_i}{t}$

$= \dfrac{5.0 \times 10^1\text{ m/s} - 0.0\text{ m/s}}{8.0 \times 10^{-2}\text{ s}}$

$= 630\text{ m/s}^2$

b. $d_f = d_i + v_i t + \dfrac{1}{2}at^2$

$= 0.0\text{ m} + (0.0\text{ m/s})(0.80\text{ s}) + \dfrac{1}{2}\left(630\text{ m/s}^2\right)(0.0800\text{ s})^2$

$= 2.0\text{ m}$

PTS: 1

15. ANS:
a. Her acceleration due to gravity is 9.80 m/s².

b. $d_f = d_i + v_i t + \frac{1}{2}at^2$, v_i and $d_i = 0$

Solve for t:

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

$= \sqrt{\frac{2 \times 10.0\text{m}}{}}$

$= 1.43\text{s}$

c. $v_f = v_i + at$
$= 0.0$ m/s + (9.80 m/s²)(1.43 s)
$= 14.0$ m/s

PTS: 1

16. ANS:
a. He is slowing down

b. $a = \frac{\Delta v}{t}$

$= \frac{v_f - v_i}{}$

$= \frac{1.5\text{m/s} - 1.5\text{m/s}}{}$

$= 0.0\text{m/s}$

c. $a = \frac{\Delta v}{t}$

$= \frac{v_f - v_i}{t_f - t_i}$

$= \frac{0.0\text{m/s} - 3.0\text{m/s}}{}$

$= 3.0\text{m/s}$

d. $a = \frac{\Delta v}{t}$

$= \frac{v_f - v_i}{t_f - t_i}$

$= \frac{1.5\text{m/s} - 0.0\text{m/s}}{}$

$= 1.5\text{m/s}^2$

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

$= 0.0\text{m} + (0.0\text{m/s})(5.0\text{s}) + \frac{1}{2}\left(0.15\text{m/s}^2\right)(5.0\text{s})^2$

$= 1.9\text{m}$

PTS: 1

17. ANS:

$d_f = d_i + v_i t_f + \frac{1}{2} a t^2$

$d_f - d_i = v_i t_f + \frac{1}{2} a t^2$

$v_i = 0$

$\Delta d = a t^2$ where $a = -g$

$\Delta d = \frac{1}{2} g t^2$

$= -\frac{1}{2}\left(9.80 \text{ m/s}^2\right)(8.0 \text{ s})^2$

$= -310 \text{ m}$

1000.0 m + (−310 m) = 690 m above the ground

PTS: 1

18. ANS:

$a = \frac{v_f - v_i}{t_f - t_i} = \frac{0.0 \text{ m/s} - 5.0 \text{ m/s}}{}$

$= 2.5 \text{ m/s}^2$

$F = ma$

$= 80 \text{ kg} \times \left(-2.5 \text{ m/s}^2\right)$

$= -200 \text{ N}$

PTS: 1

19. ANS:

a. Impulse = $F\Delta t$ $m\Delta v$

$F\Delta t = mv_f - mv_i$

$= mv_f - 0$

= (0.045 kg)(+38 m/s)

= +1.7 kg·m/s or +1.7 N·s

b. $F\Delta t$ = Impulse = 1.7 N·s

$F = \frac{\text{Impulse}}{\Delta t}$

$= \frac{+1.7 \text{ N} \cdot \text{s}}{2.0 \times 10^{-3} \text{ s}}$

$= +8.5 \times 10^2 \text{ N}$

c. $F_{\text{golf ball on club}} = -F_{\text{club on golf ball}}$

$F_{\text{club on golf ball}} = 18.5 \times 10^2 \text{ N}$

$F_{\text{golf ball on club}} = -8.5 \times 10^2 \text{ N}$

PTS: 1

20. ANS:

a. impulse = $F\Delta t$ $m\Delta v$

= (0.0420 kg)(12.0 m/s − 6.0 m/s)

= 0.25 kg·m/s

b. impulse = $F\Delta t$

$F = \frac{\text{impulse}}{\Delta t}$

$= \frac{0.25 \text{ kg} \cdot \text{m/s}}{0.040 \text{ s}}$

$= 6.2 \text{ N}$

PTS: 1

21. ANS:

Impulse = $F\Delta t = m\Delta v$

$F\Delta t = mv_f - mv_i$

$v_f = \frac{F\Delta t + mv_i}{m}$

$= \frac{\left(5.70 \times 10^3 \text{ N}\right)\left(1.00 \times 10^{-3} \text{ s}\right) + \left(0.600 \text{ kg}\right)(-50.0 \text{ m/s})}{0.0600 \text{ kg}}$

$= +45.0 \text{ m/s}$ (i.e., traveling in the opposite direction)

PTS: 1

22. ANS:

$p_f = p_i$ by conservation of momentum

$m_\alpha v_\alpha + m_{Th} v_{Th} = m_U v_U$

$v_U = 0 \text{ m/s}$

$v_{Th} = \dfrac{m_\alpha v_\alpha}{m_{Th}}$

$m_\alpha + m_{Th} = m_U$

$m_{Th} = m_U - m_\alpha$

$v_{Th} = \dfrac{m_\alpha v_\alpha}{m_U - m_\alpha}$

$= \dfrac{\left(6.68 \times 10^{-27} \text{ kg}\right)\left(2.10 \times 10^{7} \text{ m/s}\right)}{3.97 \times 10^{-25} \text{ kg} - 6.68 \times 10^{-27} \text{ kg}}$

$= -3.59 \times 10^{5} \text{ m/s}$

PTS: 1

23. ANS:

$p_f = p_i$

$= p_{bullet,i} + p_{block,i}$

$(m_{bullet} + m_{block}) v_f = m_{bullet} v_{bullet,i} + m_{block} v_{block,i}$

$= m_{bullet} v_{bullet,i} + 0$

$v_{bullet,i} = \dfrac{(m_{bullet} + m_{block}) v_f}{m_{bullet}}$

$= \dfrac{\left(1.00 \times 10^{-2} \text{ kg} + 5.00 \text{ kg}\right)(0.600 \text{ m/s})}{1.00 \times 10^{-2} \text{ kg}}$

$= 301 \text{ m/s}$

PTS: 1

24. ANS:

$p_{Af} + p_{Bf} = p_{Ai} + p_{Bi}$

$m_{Aisha} v_{Aisha,f} + 2 m_{boot} v_{boot,f} = (m_{Aisha} + 2 m_{boot}) v_i = 0$

$v_{Aisha,f} = -\dfrac{2 m_{boot} v_{boot,f}}{m_{Aisha}}$

$m_{Aisha} = \dfrac{F_{g,Aisha}}{g} = \dfrac{637 \text{ N}}{9.80 \text{ m/s}^2} = 65.0 \text{ kg}$

$v_{Aisha,f} = -\dfrac{2(4.50 \text{ kg})(6.00 \text{ m/s})}{65.0 \text{ kg}}$

$= -0.831 \text{ m/s}$

$= 0.831 \text{ m/s}$ backward or in the direction opposite to the thrown boots

PTS: 1