**Physics Final Part B**

**Short Answer**

1. What is a motion diagram?

2. What is the significance of defining a coordinate system to study the motion of an object?

3. How is displacement different from distance? Under what conditions can an object travel a certain distance and yet its resultant displacement be zero?

4. What is the equation of motion for average velocity?

5. Define average velocity.

6. The position-time graph of an object is found to be a straight line passing through the origin. What information about the motion of the object is provided by the graph?

7. Given below is the position-time graph representing motions of two runners, Nick and Ian. Use this graph to determine which runner has greater average velocity.



8. Given below is the particle model of a boy skating on a smooth, pedestrian-free sidewalk. The time interval between successive dots is 2 s.

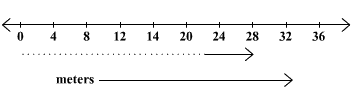


Plot a position-time graph to represent the motion of the boy.

9. The position-time graph given below represents the motion of Ted returning home from the market on his bike. What is the similarity between his displacement and the average velocity?



10. Given below is the motion diagram of a small ball rolling straight on a frictionless surface.



The time interval between successive positions is 1 s.

a. What is the displacement of the ball after 3 s?

b. Where does the ball reach after 5 s?

c. After rolling for 7 s, the direction of motion of the ball is changed. It starts rolling toward its starting point. Assume the coordinate system and the speed of the ball to remain unchanged. What is the displacement of the ball between 7 s and 9 s?

11. Given below is the graph representing the position-time graphs of two swimmers (A and B), swimming in a pool along a straight line. Both the swimmers start from two different positions. Use the graph to find when and where swimmer B passes swimmer A.



12. The position-time graph of a pedestrian is given below. What is his displacement after 2.5 s?



13. What information is provided by the points on the line of a position-time graph of an object?

14. A boy starts from point A and moves 5 units toward the east, then turns back and moves 3 units toward the west. What is the displacement in the position of the boy?

15. What are the two attributes of the coordinate system chosen for a motion diagram?

16. How is the time interval affected when the origin of the coordinate system of a motion diagram is changed?

17. What is the distance traveled by a vehicle in 12 minutes, if its speed is 35 km/h?

18. Given below is the position-time graph representing the motion of two friends, A and B, jogging in a park. Use this graph to find their displacements after 4 s.



19. Explain the difference between average velocity and instantaneous velocity.

20. Give examples of the four types of motion.

21. In 2005, Lance Armstrong won the 92nd Tour de France by riding 3608 km in 86 hours, 15 minutes and 2 seconds. Ivan Bosso came in second, 4 minutes and 41 seconds behind Armstrong. Michael Rasmussen came in 7th place, 11 minutes and 33 seconds behind Armstrong. What was the average velocity for each rider?

22. A car is traveling north at 88 km/hr (55 mph) on a two-lane road and enters the south end of a two-way passing zone that is 500 m long. A southbound car enters the north end of the passing zone and wishes to pass a car in front of it. How much time does the southbound driver have to pass the car and return to its lane without hitting the northbound car, if it is going 129 km/hr (80 mph)?

23. For constant time intervals in a motion diagram, what can be concluded about a moving object that has larger and larger distances between images of the object?

24. For constant time intervals in a motion diagram, what can be concluded about a moving object that has smaller and smaller distances between images of the object?

25. Why is it important to choose a coordinate system of the same order of magnitude as the motion being described?

26. Under what circumstances can the average velocity of a moving object be zero when its average speed is 50 km/hr?

27. What is the equation of motion for average speed?

28. The position-time graph of two objects is found to be a straight line that passes through the origin with a slope of 0.8, and another straight line starting at point (1, 5) and crossing the x-axis at (21, 0).

At which point do the two object collide?

29. What is the average velocity of the first object? Of the second object?

30. Fluffy, a greyhound, travels 15 m in 2 seconds while another greyhound, Tiberius, travels 20 m in 3 seconds.

Construct a position-time graph comparing the two dogs.

31. Fluffy, a greyhound, travels 15 m in 2 seconds while another greyhound, Tiberius, travels 20 m in 3 seconds.

Which dog runs faster?

32. Atalanta and Xun run track for their school. During practice, they run some time trials. Atalanta’s times for the 100. m dash are: 12.3 s, 12.2 s, and 12.3 s. Xun’s times for the 50. m dash are: 6.2 s, 6.5 s, and 6.7 s. Construct a graph of the runners’ time trials. What is the average velocity overall for each runner? Which runner is faster?

33. A bowler rolls a bowling ball down the gutter. The ball travels 60 feet in 5 seconds. Draw a particle model motion diagram with 1 second intervals. Construct the corresponding position-time graph.

34. Mohinder leaves home and rides his bike north at 40 km/hr for 6 km. He stops at the store and spends 5 minutes buying a magazine. He gets back on his bike and rides south for 2 km at a speed of 45 km/hr. He stops at the bank and spends 10 minutes doing his banking.

Construct a position-time graph that shows each leg of Mohinder’s progress from home to the bank. What is his average velocity?

35. Mohinder leaves home and rides his bike north at 40 km/hr for 6 km. He stops at the store and spends 5 minutes buying a magazine. He gets back on his bike and rides south for 2 km at a speed of 45 km/hr. He stops at the bank and spends 10 minutes doing his banking.

If Mohinder leaves the bank and rides 5 km north to the coffee shop at a speed of 45 km/hr, what is his average velocity for the entire outing?

Below is a motion diagram for an inline skater going in a straight line. The time interval between successive positions is 2 s.



36. What is the displacement of the skater after 5 s?

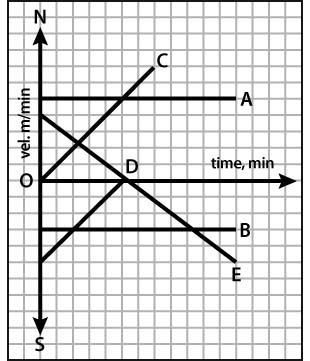
37. After rolling for 10 s, the direction of motion of the skater is changed so that she starts rolling towards her starting point. Assume that the coordinate system and the speed of the skater do not change. What is the displacement of the skater between 10 s and 13 s?

38. After 13 s, the skater again reverses direction, and starts rolling away from her starting point at the same speed, in the same coordinate system. What is the displacement of the skater between 13 s and 17 s?

39. The velocity-time graph of a car’s motion is given below. Plot the corresponding acceleration-time graph.



40. What does it mean to have “seconds squared” in the denominator of the unit for acceleration due to gravity?



41. Describe the motion represented by line E.

42. What is represented by line D?

43. What is the difference between average acceleration and instantaneous acceleration?

44. If Captain Rocket is out exploring the universe at speeds near the speed of light for years at a time, will his younger brother Rene always be his younger brother?

45. A piano is hoisted up into an apartment via a cable winch.

46. You are a skydiving physicist. During a dive, you observe that two unequal masses hung over a pulley remain balanced, that is, there is no tendency for the pulley to turn. What conclusions can you draw?

47. An object in uniform circular motion moves at a constant speed around a circle with a fixed radius. Why is the object said to be accelerating though it has a constant speed?

48. Two toy dart guns are fired from the same height horizontally at the refrigerator. One dart’s suction cup sticks to the refrigerator door, but the other dart falls short. Explain why this may have happened.

49. What is meant by the statement “the vertical and horizontal motions of a projectile are independent”?

50. When throwing a baseball, why is the maximum range obtained from releasing the ball at an angle 45o to the horizontal?

51. If there is no such thing as centrifugal force, what causes you to slide to the outside of the seat when riding an amusement park ride that spins you in circles?

52. Given va/c = va/b + vb/c: If va/b is the velocity of object A in observer B’s frame of reference, and vb/c is the motion of observer B’s frame of reference as measured in observer C’s frame of reference, what is va/c?

53. When working in one dimension, what is the difference between adding and subtracting vector quantities, as compared to scalar quantities?

54. Explain whether the velocity of an object as measured by a stationary observer in a constant-velocity frame of reference is affected by the motion of the frame of reference.

55. Two people are riding a merry-go-round. One person is riding close to the inside edge of the platform, and the other is riding on the outside edge. The platform is 5 m wide, and the whole merry-go-round has a diameter of 20 m. The merry-go-round is making one rotation every 90 seconds.

In general terms, how does the acceleration of a person on a merry-go-round (or other rotating disc) vary with the radius of the disc?

56. The gravitational constant, G, is 6.67390 x 10-11 N  m2 / kg2. What units must the orbital period have in order to use this value of G in an equation?

57. For any planet, if the planet were to shrink, but have a constant mass, what would happen to the value of g on the planet’s surface?

58. For any planet, if the planet were to expand, but have a constant mass, what would happen to the value of g on the planet’s surface?

59. If everything else is constant, when a satellite’s orbit moves farther away from a planet, what happens to the speed of the satellite?

60. If everything else is constant, when a satellite’s orbit moves farther away from a planet, what happens to the period of the satellite?

61. What happens to an object’s weight as it moves farther from Earth?

62. Earth moves more quickly in its orbit during winter in the northern hemisphere than it does during summer. Is Earth closer to the Sun in winter or in summer?

63. State the impulse-momentum theorem.

64. State the units for angular momentum.

65. Suppose a car hits a wall and comes to a rapid stop. The initial momentum is given by the velocity and mass of the car, and the final momentum is zero. Since these two factors (initial and final momentum) are the only things that determine impulse, how can a seat belt or air bag save lives?

66. If two asteroids collide in the asteroid belt, their fragments are still affected by the gravitational pull of the Sun. Does this mean the colliding asteroids cannot be considered a closed, isolated system? Why or why not?

67. An ion engine on a deep space probe produces as much force as a single sheet of paper on your hand. How can this small force propel a large spacecraft?

68. Analyze the collision of a baseball with a bat. At what point or points during the collision is the baseball’s horizontal acceleration zero? At what point or points is the baseball’s acceleration not zero? Explain your answer.

69. The maximum force on a baseball during a ball-bat collision is 1.5  104 N. The time for the collision is 3.0  10-3 sec. Does this mean the change in momentum on the ball is 1.5  104 N x 3.0  10-3 sec? If so, a 1.45  10-1 baseball will experience a velocity change of 310 m/s (about 690 miles per hour). This is unreasonable. Where is the mistake?

70. If an object’s momentum is constant, then it’s velocity is also constant as long as it neither loses nor gains mass. However, angular velocity can change even if angular momentum and mass are both constant. Why?

71. Under what circumstances is the following statement true? “If two skaters standing still push against each other, the speed of the first is the same as the speed of the second, and in the opposite direction.”

72. In the collision of two billiard balls, one ball moves from east to west and impacts a second ball that is initially at rest. That second ball moves northeast to southwest, while the first ball continues on its east-west path. Is this possible? Why or why not?

73. If angular momentum is conserved, how does an ice skater ever stop spinning?

74. What if the mass of a particle were to suddenly drop to zero? According to the information in chapter 9, what would happen to the momentum of the particle?

75. When mass is equal, a ring has a higher moment of inertia than a solid disk. A hollow ball has a higher moment of inertia than a solid ball. An ice skater with arms outstretched has a higher moment of inertia than an ice skater with arms pulled in. Combine these ideas into a general statement of the relationship between mass distribution and moment of inertia.

76. State the work-energy theorem.

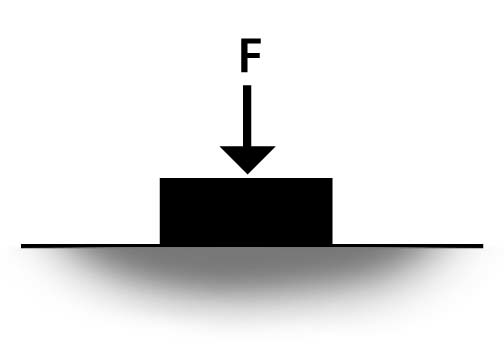
77. What are the two equivalent expressions of the efficiency of a machine?

78. What are the units for work and energy?

79. What is the mechanical advantage of any machine?

80. According to the work-energy theorem, what happens to the kinetic energy of an object when work is done *on* that object?

81. Predict whether the box shown in the diagram will gain kinetic energy.



82. A spring is compressed over a distance of 0.25 meters. The force required to hold the compressed spring is 64 newtons. Explain why the work done on the spring is not 50 N  0.25 m = 16 joules.

83. In a tug-of-war, each side pulls with a force of 500 newtons, but the rope does not move. How much work is done?

84. A screw is sometimes defined as a simple machine, and sometimes defined as a compound machine, comprised of wedge and an inclined plane. Describe the screw as a combination of a wedge and an inclined plane.

85. If an elevator and I both lift 100 kg up 3 flights (10 meters) but I reach the top before the elevator, which has produced more power?

86. A ball is attached to a string. The ball is swung about in a circle, with the central force provided by the string. Does the string do any work on the ball? Why or why not?

87. A figure skater spins in place. Does she have kinetic energy? Why?

88. A skier travels down a slope toward the bottom of the hill. At what point(s) on the slope will gravitational potential energy and kinetic energy be equal? Ignore the effects of friction.

89. If a tennis ball is carefully balanced on top of a basketball and the two are dropped together, they will maintain this relationship as they fall. When the basketball collides with the ground, it will rebound and impact the tennis ball, sending the tennis ball flying upward at great speed.

What about the basketball? Will it bounce higher, lower, or the same as when it is dropped from the same height with no tennis ball on top?

90. If a driver slowly stops a car by pumping the brakes, so that the tires don’t skid, where does the car’s kinetic energy go?

91. Two snowballs collide and partially melt. Is this an elastic or an inelastic collision?

92. On the Moon, the acceleration due to gravity is around 1.6 m/. How does this affect gravitational potential and kinetic energy of objects dropped from a height on the Moon as compared with Earth?

93. Four identical insulated containers hold equal masses of different liquids at 0°C. Identical immersion heaters supply heat at the same rate to all liquids. The specific heats and the boiling points of the liquids are provided below. Which liquid will boil first?

|  |  |  |
| --- | --- | --- |
| **Liquid** | **Specific heat** | **Boiling point** |
| A | 900 J/kgK | 45C |
| B | 2500 J/kgK | 70C |
| C | 400 J/kgK | 75C |
| D | 150 J/kgK | 500C |

94. Explain why the air that comes out of a burst tire is cooler than the surrounding air.

95. What is the change in the internal energy of a gaseous system in a cyclic process?

96. Compare and contrast warm-blooded animals (endotherms) with cold-blooded animals (ectotherms).

97. Explain why the heat of fusion and heat of vaporization do not depend on a substance’s temperature.

98. James places a 100 g block of copper at 50C next to a 100 g block of silver at 20C. He asserts that at thermal equilibrium, the final temperatures of both blocks of metal will be 35C. Do you agree with James? Explain why or why not.

99. Explain the meaning of the negative sign in the equation for Hooke’s Law.

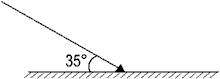
100. What conditions are necessary for *resonance* to occur?

101. An incident wave is propagated down a spring. When it meets another spring, some of the energy continues down the spring, while some is reflected back on the first spring, but inverted. Predict how the second spring compares to the first in terms of stiffness or heaviness.

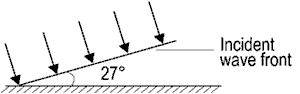
102. Propose a scenario where the Doppler effect would cause a sound to decrease in frequency.

103. Several instruments can play the same note but have distinctive sound qualities. How are these different sounds produced if the frequencies are the same?

104. What is the angle of incidence of the ray shown below?



105. What is the angle of reflection for the incident rays shown below?



106. How can plane mirrors be used to make a room appear bigger?

107. Besides a plane mirror, what type of mirror is used as a rear view mirror in cars and why?

108. What is the angle of reflection for the incident ray shown below?



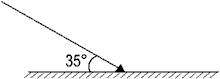
109. Explain why convex mirrors can only produce virtual images.

110. Describe the image position, size, and type produced by a plane mirror.

111. Where should an object be placed relative to a concave mirror in order to produce a virtual image?

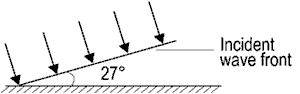
112. A mirror has a magnification of 2.5. Explain what this means in terms of the object produced.

113. What is the angle of incidence of the ray shown below?



114. An object in complete darkness is illuminated by a narrow beam of light, and an observer is located behind the source of light. The object is made of a smooth, polished material. What can be done to the surface of the object to minimize the risk of its detection?

115. What is the angle of reflection for the incident rays shown below?



116. Besides a plane mirror, what type of mirror is used as a rear view mirror in cars and why?

117. What is the angle of reflection for the incident ray shown below?



118. Describe the image position, size, and type produced by a plane mirror.

119. Where should an object be placed relative to a concave mirror in order to produce a virtual image?

120. A mirror has a magnification of 2.5. Explain what this means in terms of the object produced.

**Problem**

121. The velocity-time graph of the motion of a particle is shown below. Calculate the total displacement of the particle from 0 to 29 seconds.



122. A ball is thrown vertically upward with a speed of 1.53 m/s from a point 4.21 m above the ground. Calculate the time in which the ball will reach the ground.

123. A car accelerates from rest at 5 m/s2 for 5 seconds. It moves with a constant velocity for some time, and then decelerates at 5 m/s2 to come to rest. The entire journey takes 25 seconds. Plot the velocity-time graph of the motion.

124. A boy throws a ball vertically upward with a speed of 19 m/s. Calculate the speed of the ball when it is at a height equal to 0.77 times the maximum height reached by the ball.

125. A woman tosses a ball straight upward at 25 m/s. How long is the ball in the air?

126. A gazelle is running in a straight line with a constant velocity of 1340 m/min. A cheetah can accelerate from 0 m/min to 1820 m/min in 3 seconds.

What is the average acceleration of the **gazelle**?

127. FiFi the circus dog sits up and bounces a ball straight up and down on her nose. The initial velocity of the toss was 1.4 m/s. How many bounces are possible for FiFi to do in 1 minute?

128. A table tennis champion bounces a ping-pong ball up and down on his paddle at a rate of 300 bounces per minute. What is the initial upward velocity of the ball?

129. A truck traveling at a constant speed of 40.0 km/h applies its brakes and comes to a complete stop in 5.0 s.

a. Convert the truck’s constant speed from km/h to m/s.

b. Draw a simple *v-t* graph of the truck stopping. Use *v =* m/s*.*

c. Calculate the average acceleration for the truck. What does this value mean?

d. The truck starts again and accelerates at a constant rate of 0.80 m/s2. Beginning at the stopping point of the truck, extend the graph to show 10.0 s of this new constant acceleration.

e. After restarting, how much time does it take for the truck to regain its original speed of 40.0 km/h?

f. After restarting, how far does the truck travel before reaching its original speed of 40.0 km/h?

130. A car of mass 1330 kg is traveling at 28.0 m/s. The driver applies the brakes to bring the car to rest over a distance of 79.0 m. Calculate the retarding force acting on the car.

131. An elevator is moving down with an acceleration of 1.40 m/s2. A 14.5-kg block hangs from a spring balance fixed to the roof of the elevator. What is the apparent weight of the block?

132. A 2.1-kg block is kept on a 3.5-kg block resting on the floor of an elevator. If the elevator is moving up at 1.1 m/s2, calculate the following:

a. Force exerted by the 2.1-kg block on the 3.5-kg block.

b. Force exerted by the floor of the elevator on the 3.5-kg block.

133. Two horizontal forces, 315 N and 145 N are applied to a sled resting on a frictionless skating rink. If they are applied in the *same* direction, what is the net horizontal force on the sled?

134. A force of 5 N is the only force exerted on a sled on a slippery driveway. The acceleration is measured to be A. When the same force is exerted on a second sled, the acceleration is 1/4 A. What can you conclude about the masses of the two sleds?

135. A 1.5 kg hawk with a mass of 0.750 kg lands on a child’s swing. What is the tension in the two vertical ropes of the swing?

136. A 5.0 kg mass , , and a 7.0 kg mass, , are connected to a lightweight cord that passes over a frictionless pulley. The pulley only changes the direction of the force exerted by the rope. The hanging masses are free to move. What is the acceleration of  if gravity acts in the negative direction?

137. A crate with a mass of 450 kg rests on the bed of a truck that is moving at a speed of 90.0 km/h. The driver brakes and slows to a speed of 50.0 km/h in 15 s. Assuming the force is constant, what force acts on the crate during this time? Assume that the crate does not slide on the bed of the truck.

138. An astronaut is preparing calculations for a flight to the Moon. The combined mass of the crew, all equipment, fuel, and the rocket is 2.8106 kg on the launch pad.

a. The rocket’s engines produce a combined 35106 N of thrust. Is this enough to lift the rocket and its payload? What if the engines produced 30106 N of thrust? Would 25106 N be enough?

b. What is the minimum force the rocket needs to exert in order to lift off the ground and accelerate upward?

c. To return to Earth, the crew must take off from the Moon, where gravity is one-sixth that of Earth. Since most of the mass of the rocket is fuel, assume that three-fourths of the mass was lost in the journey to the Moon. How much force does the rocket need to exert in order to lift off the surface of the Moon?

139. A river flows at a speed of 4.60 m/s. A boat, capable of moving with a speed of 5.80 m/s in still water is rowed across the river at an angle of 53.0° to the river flow. Calculate the resultant velocity with which the boat moves and the angle that its resultant motion makes to the river flow.

140. What should be the angle between two vectors of magnitudes 3.20 and 5.70 units, so that their resultant has a magnitude of 6.10 units?

141. An airplane has to fly eastward to a destination 856 km away. If wind is blowing at 18.0 m/s northward and the air speed of the plane is 161 m/s, in what direction should the plane head to reach its destination?

142. A mover pushes a 30.0 kg crate across a wooden floor at a constant speed of 0.75 m/s. If the coefficient of static friction for wood-on-wood is 0.20, how much force does the mover exert on the crate?

143. A mover pushes a 30.0 kg crate across a wooden floor at a constant speed of 0.75 m/s. If the coefficient of static friction for wood-on-wood is 0.20, what is the **normal force** exerted by the floor on the crate?

144. A 200 liter drum of high fructose corn syrup with a weight of 2891 N rests on a loading ramp that is inclined  above the horizontal. Find the components of the weight forces that are parallel and perpendicular to the plane.

145. A giraffe trots 3.40 km due north, then 2.60 km due west. What is the magnitude of its displacement?

146. A lion runs 2.40 km due north, then 3.60 km due west. That is the direction of the lion’s overall displacement?

147. A cyclist goes 12.76 km east, then turns due south and rides another 5.85 km. What is the direction of the cyclist’s overall displacement?

148. Two ants are using some spider webs to hoist a dead grasshopper into a tree for safe keeping. The grasshopper has a mass of 6 g. One ant stands on a branch on the left and pulls with a force of 0.15 N and the other stands at on a branch to the right and pulls with a force of 0.19 N. The web forms a perfectly vertical “V” with a 35 angle. Find the x- and y-components of the net force on the grasshopper.

149. A racecar driver is driving her car down the drag strip at 120 m/s. What is the shortest distance in which she can brake and stop if the coefficient of static friction between the tires and the road is 0.71? What does this tell you about the design of cars used in drag racing?

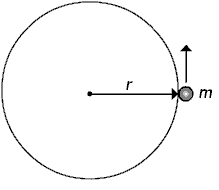
150. June starts out hiking due south and travels 4.50 km. When she comes to a canyon running east to west, she turns due east and travels 12.0 km before stopping for the night.

a. How far did she travel this first day? Draw the vectors of the distances walked.

b. The next day, June consults her map and sets out on a path 35.0° south of due east, hiking 7.75 km before coming to a river flowing from north to south. She turns due south and follows the river for 11.0 km, and again she stops for the night. How far did she travel this second day? Draw the vectors of the distances walked.

c. After two days of hiking, how far is June from her original starting point?

151. A ball is tied to an elastic string of length 8.0 m and swung in a horizontal circle with a velocity of 0.8 m/s. When a metallic object is tied to a rope of length 2.75 m and swung in a horizontal circle, it makes one revolution in 2.9 s. The ratio of the centripetal force in the string to the centripetal force in the rope is . Find the mass of the metallic object attached to the rope, if the centripetal force in the string is 0.20 N.



152. A boat traveling east covers a distance of 40.0 m in 20.0 s. It encounters a current moving at a speed of 2.50 m/s traveling north. Find the resultant velocity of the boat.

153. A riverboat travels with a velocity of 4.60 m/s from one shore to another. The velocity of the river is 2.30 m/s. If the width of the river is 72.0 m, how far does the boat travel downstream to reach the other shore?

154. Two boats, A and B, travel with a velocity of 4.90 m/s across a river of width 72.0 m. The river flows with a velocity of 2.50 m/s. Boat A travels the shortest distance and boat B travels in the shortest time. If both start at the same time, how much time will they take to cross the river?

155. A human cannonball is launched from a cannon at 20 m/s at  above the horizontal. What is the maximum height of the human cannonball?

156. A human cannonball is launched from a cannon at 20 m/s at  above the horizontal. What is the range of the human cannonball?

157. A football is kicked from a tee at 12 m/s at  above the horizontal. What is the maximum height of the football?

158. A football is kicked from a tee at 12 m/s at  above the horizontal. What is the flight time of the football?

159. A spider twirls a fruit fly around in a circle at the end of a web. If the web is 17.6 cm long, and the velocity of the fly is 110 cm/s, how much time does it take for the fly to make one complete revolution?

160. An antelope moving at a speed of 16 m/s rounds a bend. What is the radius of the tightest curve that the antelope can make if the centripetal acceleration does not exceed 20.0 m/s2?

161. A power walker strolls at 6.5 km/hr relative to a cruise ship from the front of that cruise ship toward the back. The ship is sailing forward at 80.0 km/hr. What is the speed of the walker relative to the water?

162. Josephine and Sunhee are playing shuffleboard on the deck of a cruise ship. The ship is sailing due north at a speed of 3.0 m/s. If Sunhee slides her puck along the deck, from the front toward the back of the ship at 7.0 m/s, what is the velocity of the puck relative to the water?

163. Bad Bart and Mean Mary are outlaws who are robbing a train in the Old West. The train is traveling east at a speed of 13.0 m/s. If they make their escape by running west across the top of the train at a speed of 4.0 m/s, what is their velocity relative to the tracks?

164. Josephine and Sunhee are playing shuffleboard on the deck of a cruise ship. The ship is sailing due north at a speed of 3.0 m/s. If Sunhee slides her puck along the deck, from east to west at 9.0 m/s, what is the velocity of the puck relative to the water?

165. Two people are riding a merry-go-round. One person is riding close to the inside edge of the platform, and the other is riding on the outside edge. The platform is 5.0 m wide, and the whole merry-go-round has a diameter of 20.0 m. The merry-go-round is making one rotation every 90 seconds.

What is the speed of the outside rider relative to that of the inside rider?

166. A paintball is shot horizontally from a paintball marker 1.75 m above the ground. The initial velocity of the paintball is 270 m/s. How long will it take for the bullet to hit the ground?

167. Calculate the force of gravitational attraction between two spheres of mass 10.1 kg and 45.4 kg that are 38.5 m apart.

168. Venus has radius  m and mass  kg. Calculate the value of acceleration due to gravity on Venus’s surface.

169. If Earth shrinks in size such that its shape and mass remain the same, but the radius decreases to 0.21 times its original value, find the acceleration due to gravity on its surface.

170. At what height above Earth’s surface does the gravitational intensity becomes 0.67 times its value on the surface of Earth? Given the radius of the Earth is 6.40  106 m.

171. What is the orbital period, T, of Phobos in seconds?

172. What is the orbital period, T, of Deimos in seconds?

173. The units for the gravitational constant, G, are Nm2 / kg2. Simplify this set of units.

174. What is the gravitational force between two 0.300 kg coffee mugs that are 0.75 m apart?

175. Assume that a satellite orbits Mars 150 km above its surface. Given that the mass of Mars is 6.4185  1023 kg, and the radius of Mars is 3.396  106 m, what is the satellite’s speed?

176. so what What is the gravitational field of a spherical paperweight at the paperweight’s surface that has a mass of 1950 g and is 8.00 cm across?

177. Assuming Earth behaves as a perfect sphere with a radius of 6380 km, the standard gravitational acceleration, *g*, at sea level has a value of 9.80 m/s2.

a. As Earth rotates on its axis, objects at the equator experience a slightly different value of *g* due to additional centripetal acceleration. Calculate this adjusted value for *g*.

b. Is this difference due to centripetal forces present at the poles? If *g* is dependent upon the position on the surface of Earth, why do we use the standard value of 9.80 m/s2 in our calculations? Explain.

c. What is the value of g on board a space shuttle in a stable orbit at a height of 350 km above the equator? *Hint: You do not need to know the mass of the space shuttle*.

178. Astronomers discover a new planet orbiting a fixed point in space, but for reasons unknown, they cannot directly observe a star where one is expected. The radius of the orbit is measured to be 1.85108 km, and the lone planet completes an orbit once every 530 days.

a. Calculate the mass of the unseen star or other celestial object this planet is orbiting.

b. For an orbit to be stable, the centripetal force must exactly equal the force of gravitational attraction between two bodies. If this planet orbited the object once every 580 days, would this be a stable orbit? Explain. Assume this planet is about the same size as Earth, and use the mass of the hidden object found in part **a**.

179. A 6110-kg bus traveling at 20.0 m/s can be stopped in 24.0 s by gently applying the brakes. If the driver slams on the brakes, the bus stops in 3.90 s. What is the average force exerted on the bus in both these stops?

180. A 0.140-kg baseball is pitched horizontally at 36.7 m/s. When a player hits the ball, it moves at the same speed, but in the opposite direction. If the bat and the ball are in contact for 0.450 ms, calculate the average force the bat exerts on the ball.

181. Candona strikes a 0.055-kg golf ball with a force of 260 N. If the ball moves with a velocity of 65 m/s, calculate the time the ball is in contact with the club.

182. A force of 200 N acts on a 7.20-kg bowling ball for 0.350 s. Calculate its change in velocity.

183. A marksman at rest fires a 4.00-kg gun that expels a bullet of mass 0.0140 kg with a velocity of 181 m/s. The marksman’s mass is 81.0 kg. What is the marksman’s velocity after firing the gun?

184. A rocket expels gases at a rate of  kg/s with a speed of  m/s. What is the force exerted on the rocket?

185. A 1.5  10-2 kilogram bullet traveling at 850 m/s hits a block of wood. The bullet and wood together fly off in the same direction at 25 m/s. What is the impulse on the bullet?

186. In the previous problem, suppose the ball bounces off the wide receiver’s chest and moves in the other direction at 4 m/s. Now what is the wide receiver’s horizontal velocity?

187. If a 91 kg wide receiver running at 5.0 m/s in the y direction leaps into the air and catches a 0.45 kg ball moving 27 m/s in the x direction, what is the speed and direction of the receiver and ball just before the receiver touches the ground?

188. A mouse of mass 5.0 g spots the corner of a peanut butter sandwich of mass 8.0 g left on an ice rink after a game. Excited, the mouse runs out onto the ice, but immediately begins to slide. The mouse reaches the peanut butter sandwich and sinks its teeth in. Both the mouse and peanut butter sandwich continue to slide with a speed of 0.45 m/s. What was the initial speed of the mouse?

189. An 83-kg stunt person is performing a stunt in which he jumps from the top of a 31-m-high building into a large air bag designed to break his fall safely.

a. Calculate what the momentum of the stunt person would be at ground level if the air bag were not present. (This is the quantity the air bag must be designed to handle.)

b. To catch a person safely, the air bag must deflate, otherwise the person could rebound and land on a harder surface. What is the minimum time in which the air bag must deflate to stop this stunt person safely? Assume the stunt person comes to rest on the ground at the same moment the air bag deflates. For safety reasons, the force on the stunt person must not exceed his weight.

c. A commercially available air bag advertises that it deflates completely in 5.0 s. What is the force on the stunt person’s body if he falls into this air bag? Is this air bag safe to use for this individual? Why or why not?

d. For what maximum height can the air bag in part c be used by this stunt person?

190. A cable pulls a stationary crate of mass 19.0 kg over a frictionless ramp at an angle 20.1 above the ground. If the total distance traveled is 5.40 m, find the work done by the cable on the crate.

191. A 1600-kg vehicle moves with a velocity of 19.5 m/s. Calculate the power required to reduce the velocity to 3.20 m/s in 11.0 s.

192. Pushing a stranded dolphin back to sea requires a constant force of 600 N over a distance of 30 meters. How much work is done on the dolphin?

193. In the previous problem, change the 75 meter figure from the height of the hill to the distance along the path from the base of the hill to the top. Now what is the total work done to push the boulder up the hill?

194. You lift 220 N of water 1.0 m over a table in 0.45 seconds. What power have you generated?

195. An ideal pulley system has an MA of 5.0. What distance must you pull the rope in order to lift a 500 N weight 3.0 meters?

196. A lever’s efficiency is 95 percent. The work in is 95 J. What is the work out?

197. Andrew throws a 0.11-kg ball toward Donald, who is standing on a ledge. The ball leaves Andrew’s hands at a height of 0.24 m and Donald catches it at a height of 0.82 m. Calculate the gravitational potential energy of the ball relative to the ground before being thrown.

198. A student lifts a 1.2-kg bag from her desk, which is 0.59-m high, to a locker that is 2.9-m high. What is the gravitational potential energy of the bag relative to the desk?

199. A -kg bullet is fired with a velocity of 154 m/s toward a 5.44-kg stationary solid block resting on a surface that has a coefficient of friction 0.215. The bullet emerges with a reduced velocity of 20.2 m/s after passing through the block. What distance will the block slide before coming to rest? Assume that the block does not lose any mass.

200. A 68 kg skydiver decelerates from 55 m/s to 5 m/s when the skydiver’s parachute opens. What work is done on the skydiver by the parachute?

201. A pod of ten dolphins, with a total mass of 4500 kg, speeds up from 3.0 m/s to 7.3 m/s to catch up with a school of fish. What are the initial and final kinetic energies of the pod, and how much work was done by the pod to speed up?

202. A bowling ball suspended from the ceiling by a massless cable swings freely back and forth. If the ball’s top speed is 5.0 m/s at 0.25 m from the floor, how high will the bowling ball be when its speed is zero? Ignore friction and air resistance. Why do you not need to know the mass of the bowling ball?

203. A 91 kg man wearing a Velcro suit running with a horizontal speed of 4.4 m/s leaps into the air and impacts a stationary car of mass 880 kg sitting on a railroad track. The car is covered in Velcro, as well, and the man and the car stick together.

a) What was the initial KE of the system?

b) What is the final speed of the system?

c) What is the final KE of the system?

d) What percentage of KE was lost?

204. A particle of mass 1.7  10-27 kg moves with a velocity of +99 m/s. A particle of mass 9.1  10-31 kg flies off the particle exactly in the direction of motion with a velocity of +3  105 m/s.

a) What is the new velocity of the first particle?

b) What is the percent gain in kinetic energy?

c) Hypothesize about the source of this energy

205. A single proton has a mass of *m*p = 1.671027 kg. Traveling in a cyclotron at 90 percent of the speed of light, it strikes an atom of gold, Au, at rest. The proton rebounds with a velocity of 1.40108 m/s while the gold atom recoils at a speed of 1.64107 m/s. What is the mass of the gold atom? Assume all collisions are elastic and all motion is along the same axis.

206. A 0.10-kg copper calorimeter contains 0.15 kg of paraffin at 15.0C. When a 0.050-kg piece of aluminum at 100.0C is dropped into the calorimeter, the final temperature of the mixture is 25.0C. Calculate the specific heat capacity of paraffin. The specific heat capacities of aluminum and copper are 1.0  103 J/kgK and 4.0  102 J/kgK respectively.

207. Convert 173C to kelvins.

208. A heat engine operates between a high-temperature source and a low-temperature sink. It takes 200 J from the source and delivers 120 J to the sink. What is the efficiency of the heat engine?

209. A gas is kept in a rigid container and 100 J of heat is supplied to it. What is the work done by the gas and the change in the internal energy of the gas?

210. James Joule demonstrated the first law of thermodynamics by using a falling weight to turn a paddle wheel. Friction from the paddle heated a container of water. In one experiment, Joule used a 1826-kg mass and allowed it to fall a distance of 0.305 m as it turned the paddle.

a. How much work was done by the falling weight?

b. If the paddle churned in a bath that contained 2.20 kg of water, what was the temperature change of the water? Assume that all of the energy of the falling mass was converted into thermal energy that was absorbed by the water.

211. A spring extends to 1.20 times its unstretched length when a force of 8.50 N is applied. Assuming Hooke’s law applies to the spring, calculate the percent increase in the potential energy stored in the spring if the force is increased further and its length becomes 2.40 times its unstretched length.

212. The graph below displays how displacement varies with time when a wave passes a fixed point at a speed of 12.0 m/s. Calculate the frequency and wavelength of the wave.



213. How long must a pendulum be to have a period of 4.7 seconds?

214. How fast should a car move away from an observer for the car’s horn to sound 2.48% lower in frequency than when the car is stationary? The speed of sound is 343 m/s.

Table of Speeds of sound at 25C

|  |  |
| --- | --- |
| Copper | 3560 m/s |
| Iron | 5130 m/s |
| Gold | 3240 m/s |
| Brass | 4700 m/s |
| Lead | 1322 m/s |

215. A sound with a frequency of 256 Hz has a wavelength of 13.9 meters in a certain metal. Which metal is this likely to be? Explain your answer.

216. A 5.0-cm real object is placed at a distance of 30.0 cm from a concave mirror of focal length 10.0 cm. Find the location and size of the image.

217. What must be the minimum height of a plane mirror so that a boy of height 162 cm can view himself from head to toe?

218. Two plane mirrors are inclined at 60 to each other. A ray of light is reflected first by one mirror and then by the other. What is the angle between the incoming and outgoing rays?

219. A 5.0-cm real object is placed at a distance of 20 cm from a concave mirror of focal length 10 cm. Find the location and size of the image.

220. A concave mirror has a radius of curvature equal to 15.0 cm. If an object 1.5 cm tall is placed 20 cm in front of this mirror, what will the image position and height be?

221. For a concave mirror with the focal length of 4.6 cm, where should a 5.0-cm tall object be placed with respect to a the mirror so that it produces an 8.0-cm tall virtual image located 12 cm from the mirror?

222. A 20.0 cm tall object is placed 50.0 cm in front of a convex mirror with a radius of curvature of 34.0 cm. Where will the image be located, and how tall will it be?

223. A museum curator needs a mirror that can produce an inverted image with a magnification of 2.5 when placed 4.0 cm from an object in a display case.

a. What kind of mirror should the curator use?

b. What must be the radius of curvature?

224. A 5.0-cm real object is placed at a distance of 30.0 cm from a concave mirror of focal length 10.0 cm. Find the location and size of the image.

225. What must be the minimum height of a plane mirror so that a boy of height 162 cm can view himself from head to toe?

226. A 5.0-cm real object is placed at a distance of 5.0 cm from a concave mirror of focal length 10 cm. Find the location and size of the image.

227. A man is looking at his image in a mirror fixed on a revolving door. Find the angle through which he should move to see his image in the mirror if the door rotates by 5.

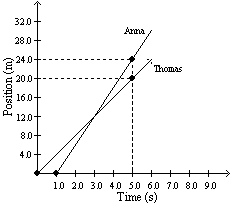
228. A 5.0-cm real object is placed at a distance of 20.0 cm from a convex mirror of focal length 10.0 cm. Find the location and size of the image.

229. A rod of length 500.0 cm lies along the axis of a convex mirror of radius of curvature 200.0 cm. The end of the rod closer to the mirror is 200.0 cm from the mirror. Find the length of the image of the rod.

230. A 20.0 cm tall object is placed 50.0 cm in front of a convex mirror with a radius of curvature of 34.0 cm. Where will the image be located, and how tall will it be?

**Essay**

231. Thomas cycles on a straight road near his house. After sometime, his sister Anna also starts cycling. Their motions are represented by the position-time graphs given below.



a. How long had Thomas been cycling when Anna started cycling?

b. What is the position at which Anna crosses Thomas?

c. What is the difference between their positions after 5 s?

232. A stroboscope is an instrument that provides intermittent illumination of an object to study various aspects of its motion. Describe how a photograph of a moving object that is illuminated by a stroboscope can be translated into a particle-model motion diagram. How will the diagram look if the object is accelerating in a constant, positive way? How will it differ from the diagram of an object undergoing constant velocity motion (zero acceleration)?

233. There are many Hollywood movies which show a hero or a villain running, jumping, or riding a motorcycle through big plate glass windows without apparent injury. Why is this an incredible violation of Newton’s laws?

234. Analyze the following statement:

In the relation ff/fi = Ii/If, units are not important.

235. Develop the plans for a device that changes the momentum of a marble. Your device might include machines that speed up or slow down the marble, change the direction of the marble, or change the marble’s mass.

236. Design a system for protecting a falling egg. The egg must fall from a height of 10 meters. What different devices might protect the egg from breaking?

237. By Newton’s Third Law, the force of a bat on a ball is accompanied by an equal force of the ball on the bat. Therefore, the change in speed of a batted ball can never be greater than the change in speed of the bat. What is wrong with this statement?

238. Criticize the following statement, based on what you know of momentum and gravity.

“When I drop a ball of clay to the ground, it sticks. The momentum started as zero, went up to a maximum just before impact, and went back to zero. Clearly, momentum is not conserved.”

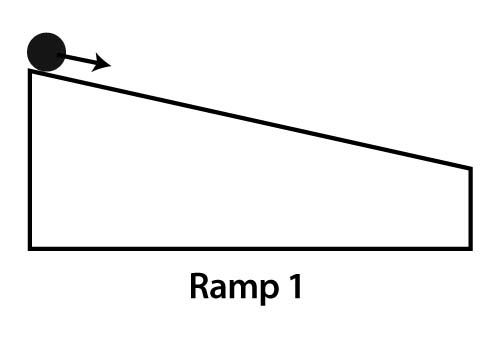
239. No real machine is 100 percent efficient. Hypothesize some of the energy losses experienced by any real machine.

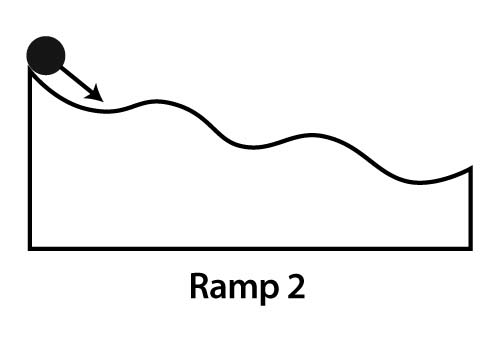
240. Why does work, even work that does not meet the physics definition of work, make us tired?

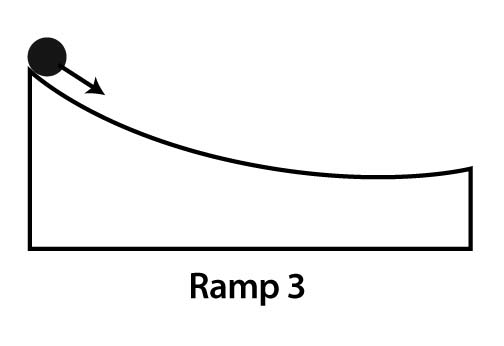
241. Velocity can be negative, but kinetic energy cannot. Why?

242. Describe a situation in which rotational kinetic energy is transformed into linear kinetic energy.

243. When I drop a clay ball to the ground, it sticks. Before I dropped the ball, its kinetic energy was zero. After it stuck to the ground, its kinetic energy was zero again. Is this an example of the conservation of energy?

244. 





Consider the diagram of three ramps. Suppose a ball is rolled down each ramp simultaneously. The balls start with the same speed, zero. Because the end points of the ramp are all at the same height, the balls must end with the same speed, as well. Will the three balls tie?

245. In climbing stairs, you store gravitational potential energy in your body, and you get tired. Why don’t you get that gravitational potential energy back as you descend those same stairs?

246. Propose an experimental design that would allow you to determine the identity of an unknown metal using thermodynamics concepts.

247. Explain how surface waves can have characteristics of both longitudinal waves and transverse waves.

248. Distinguish between constructive and destructive interference.

249. A group of students is discussing how light reflecting off a rough object can reflect in so many directions. Maria says that this is because the law of reflection does not apply to rough-surfaced objects but only to mirrors. Do you agree? Explain why or why not.

250. Plane mirrors, concave mirrors, and convex mirrors are all capable of producing virtual images. Suppose you have a different object located in front of each one of the mirrors so a virtual image is produced. Describe a method you could use to determine which mirror is of what type.

**Physics Final Part B**

**Answer Section**

**SHORT ANSWER**

1. ANS:

Motion diagram is a series of images showing the positions of a moving object at equal time intervals.

PTS: 1 DIF: Bloom’s Level 1 REF: Page 33

OBJ: 2.1.1 Draw motion diagrams to describe motion. NAT: B.4

TOP: Draw motion diagrams to describe motion. KEY: Motion diagram

MSC: 2

2. ANS:

A coordinate system tells about the location of the zero point of the variables defining the motion of the object to be studied. The coordinate system also explains the direction in which the values of the variables increase.

PTS: 1 DIF: Bloom’s Level 1 REF: Page 34

OBJ: 2.2.1 Define coordinate systems for motion problems. NAT: B.4 | UCP.1

TOP: Define coordinate systems for motion problems. KEY: Coordinate system, Origin

MSC: 2

3. ANS:

Displacement is a vector quantity, while distance is a scalar quantity. Displacement has both the magnitude and direction. Distance has only magnitude. The displacement of an object is equal to the difference between its final position and initial position. When an object starts moving from a certain point and after covering certain distance returns to its starting position, its displacement becomes zero.

PTS: 1 DIF: Bloom’s Level 2 REF: Page 37

OBJ: 2.2.3 Define displacement. NAT: B.4 TOP: Define displacement.

KEY: Distance, Displacement, Scalars, Vectors MSC: 2

4. ANS:

The equation of motion for average velocity is . In this equation, ***d*** is the position of an object, ****** is the average velocity of the object, *t* is the time and ***d***i is the initial position of the object. According to this equation, an object’s position is equal to the average velocity multiplied by time plus the initial position.

PTS: 1 DIF: Bloom’s Level 1 REF: Page 47

OBJ: 2.4.3 Create pictorial, physical, and mathematical models of motion problems.;

NAT: UCP.2 | B.4 TOP: Create pictorial, physical, and mathematical models of motion problems.;

KEY: Average velocity MSC: 2

5. ANS:

Average velocity of an object is defined as the change in position of the object moving along a straight line, divided by the time during which the change occurred. In symbolic form, the average velocity

.

PTS: 1 DIF: Bloom’s Level 2 REF: Page 44

OBJ: 2.4.1 Define velocity. NAT: B.4 TOP: Define velocity.

KEY: Average velocity MSC: 2

6. ANS:

The straight line position-time graph of a moving object gives the information about the nature of the motion of the object. It is also used to calculate the average velocity of the object. Since the graph is a straight line, the object is undergoing uniform motion. The slope of this line gives the value of the average velocity of the object.

PTS: 1 DIF: Bloom’s Level 2 REF: Page 43

OBJ: 2.4.1 Define velocity. NAT: B.4 TOP: Define velocity.

KEY: Average velocity MSC: 2

7. ANS:

The average velocity of an object is equal to the slope of the line representing the position-time graph of the object. In this graph, the slope of Ian’s line is steeper than the slope of Nick’s line. A steeper slope indicates a greater change in displacement during each time interval. Average velocity for a given time interval is proportional to the change in the displacement. Therefore, the average velocity of Ian is more than the average velocity of Nick.

PTS: 1 DIF: Bloom’s Level 3 REF: Page 43

OBJ: 2.4.1 Define velocity. NAT: B.4 TOP: Define velocity.

KEY: Average velocity MSC: 2

8. ANS:

The position-time graph corresponding to this particle model is plotted below.



PTS: 1 DIF: Bloom’s Level 3 REF: Page 40

OBJ: 2.3.1 Develop position-time graphs for moving objects. NAT: B.4

TOP: Develop position-time graphs for moving objects. KEY: Position-time graph

MSC: 2

9. ANS:

In this case, motion is in the negative direction. Therefore, displacement and velocity of the bike are negative. Hence, both the displacement and the velocity have a negative sign.

PTS: 1 DIF: Bloom’s Level 1 REF: Page 44

OBJ: 2.4.1 Define velocity. NAT: B.4 TOP: Define velocity.

KEY: Displacement, Average velocity MSC: 1

10. ANS:

a. The value of displacement after 3 s is 12 m.

b. After 5 s, the ball reaches at 20 m from its starting point.

c. The position of the ball after 7 s = 28 m.

The position of the ball after 9 s = 20 m.

The direction of the motion of the ball is reversed after 7 s. Therefore, the displacement of the ball between 7 s and 9 s = *d* = 20 – 28 = –8 m. The negative sign shows that the direction of displacement in this case is negative, toward the starting point.

PTS: 1 DIF: Bloom’s Level 3 REF: Page 36

OBJ: 2.2.5 Use a motion diagram to answer questions about an object's position or displacement.

NAT: B.4

TOP: Use a motion diagram to answer questions about an object's position or displacement.

KEY: Displacement MSC: 3

11. ANS:

The point of intersection of the two graphs is 150 m at about 38 s. Swimmer B passes Swimmer A about 150 m beyond the origin 38 s after A has passed the origin.

PTS: 1 DIF: Bloom’s Level 2 REF: Page 38

OBJ: 2.2.4 Determine a time interval. NAT: B.4 TOP: Determine a time interval.

KEY: Time interval, Origin MSC: 2

12. ANS:

The position-time graph of the pedestrian intersects the *x*-axis at 2.5 s. Thus, the displacement in 2.5 s is –10 m.

PTS: 1 DIF: Bloom’s Level 2 REF: Page 38

OBJ: 2.3.2 Use a position-time graph to interpret an object's position or displacement.

NAT: B.4 TOP: Use a position-time graph to interpret an object's position or displacement.

KEY: Position-time graph, Displacement MSC: 1

13. ANS:

The points on the line of a position-time graph of an object represent the most likely positions of the moving object at the times between the recorded data points.

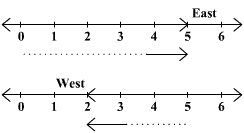
PTS: 1 DIF: Bloom’s Level 2 REF: Page 38

OBJ: 2.3.2 Use a position-time graph to interpret an object's position or displacement.

NAT: B.4 TOP: Use a position-time graph to interpret an object's position or displacement.

KEY: Position-time graph, Position MSC: 1

14. ANS:



The resultant displacement is 2 units toward the east, and his position is at 2.

PTS: 1 DIF: Bloom’s Level 2 REF: Page 34

OBJ: 2.2.5 Use a motion diagram to answer questions about an object's position or displacement.

NAT: B.4

TOP: Use a motion diagram to answer questions about an object's position or displacement.

KEY: Displacement MSC: 2

15. ANS:

The two attributes of the coordinate system chosen for a motion diagram are the origin and the axis of the coordinate system.

PTS: 1 DIF: Bloom’s Level 2 REF: Page 34

OBJ: 2.2.5 Use a motion diagram to answer questions about an object's position or displacement.

NAT: B.4

TOP: Use a motion diagram to answer questions about an object's position or displacement.

KEY: Coordinate system, Origin MSC: 2

16. ANS:

The time interval is a scalar quantity. Its value is not affected by the change in the relative position of the origin of the coordinate system.

PTS: 1 DIF: Bloom’s Level 2 REF: Page 36

OBJ: 2.2.4 Determine a time interval. NAT: B.4 TOP: Determine a time interval.

KEY: Time interval MSC: 2

17. ANS:

Speed is given in km/h, therefore convert time in minutes to hours.



distance traveled = (speed)(time taken) = (35 km/h)(12 min)(1 h/60 min) = 7.0 km

PTS: 1 DIF: Bloom’s Level 2 REF: Page 36

OBJ: 2.2.3 Define displacement. NAT: B.4 TOP: Define displacement.

KEY: Distance MSC: 2

18. ANS:

The displacements of A and B are the coordinates of the vertical line with their respective position-time graphs at 4 s.



The value of displacement of A is approximately 4 m

The value of displacement of B is approximately 3 m.

PTS: 1 DIF: Bloom’s Level 3 REF: Page 36

OBJ: 2.2.3 Define displacement. NAT: B.4 TOP: Define displacement.

KEY: Displacement MSC: 1

19. ANS:

Average velocity provides the overall change in position of an object during a time interval. It does not describe any specific changes in the motion of the object over the course of the time interval.

Instantaneous velocity gives the speed and direction of an object at a particular instant during a time interval.

PTS: 1 DIF: Bloom's Level 2 REF: pp. 44, 46

NAT: B.4

20. ANS:

Straight line: A bowling ball rolling in a gutter; a train on a straightaway; a drag-racing car; an object falling straight down; etc.

Circle: The rotation of Earth; the spinning of a wheel; the blades of a helicopter; a yo-yo; etc.

Arc: The path of a home run hit; an arrow or rifle shot; a hypnotist’s watch; a clock pendulum; a golf swing; etc.

Vibration (back and forth): A guitar string; a compressed spring that is released; a snare drum head; etc.

PTS: 1 DIF: Bloom's Level 2 REF: p. 31

NAT: B.4

21. ANS:

Armstrong = 3608 km/86.2506 hr = 41.83 km/hr

Bosso = 41.79 km/hr (= 3608 km/86.33 hr)

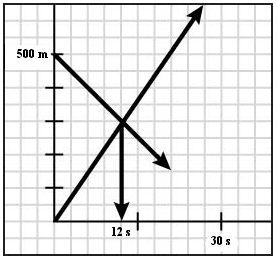
Rasmussen = 41.74 km/hr (= 3608 km/86.44 hr)

PTS: 1 DIF: Bloom's Level 3 REF: p. 43

NAT: B.4

22. ANS:

Draw the position-time graph for the two cars. The point where the lines cross gives the time to collision, which is about 12 seconds.

.

PTS: 1 DIF: Bloom's Level 3 REF: pp. 38-40, 43

NAT: B.4

23. ANS:

The object is accelerating (speeding up).

PTS: 1 DIF: Bloom's Level 4 REF: pp. 32-33

NAT: B.4

24. ANS:

The object is accelerating (slowing down).

PTS: 1 DIF: Bloom's Level 4 REF: pp. 32-33

NAT: B.4

25. ANS:

Using a coordinate system of a different order of magnitude than the motion being described could lead to loss of detail (if the coordinate system is too large for the motion being described), or the use of too many computing resources to describe the motion being studied (if the coordinate system is too small for the motion being described).

PTS: 1 DIF: Bloom's Level 6 REF: p. 34

NAT: B.4

26. ANS:

If the object travels a distance, and then returns to its starting point, the average velocity will be zero because the overall displacement will be zero.

PTS: 1 DIF: Bloom's Level 4 REF: pp. 43-44

NAT: B.4

27. ANS:

Average speed is the absolute value of average velocity.

The equation of motion for average velocity is 

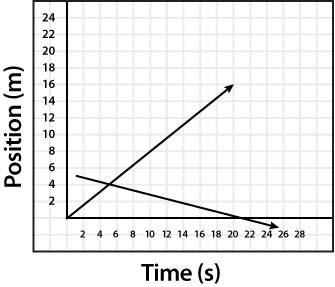
Thus the equation of motion for average speed is 

PTS: 1 DIF: Bloom's Level 3 REF: p. 44

NAT: B.4

28. ANS:

The point of collision is where the two lines intersect: (5, 4)



PTS: 1 DIF: Bloom's Level 3 REF: pp. 38-40

NAT: B.4

29. ANS:

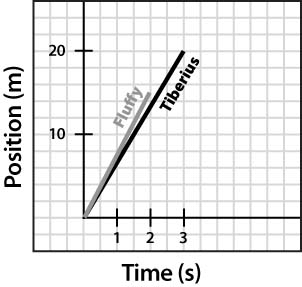
The first object’s average velocity is 0.8 m/s.

The second object’s average velocity is  m/s.

PTS: 1 DIF: Bloom's Level 5 REF: pp. 38, 43

NAT: B.4

30. ANS:



PTS: 1 DIF: Bloom's Level 4 REF: pp. 38-40, 43

NAT: B.4

31. ANS:

Fluffy runs faster.

PTS: 1 DIF: Bloom's Level 6 REF: pp. 38-40

NAT: B.4

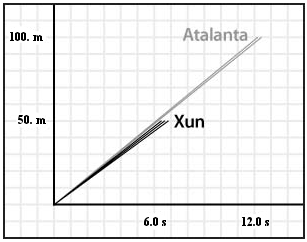
32. ANS:

Atalanta’s overall average velocity is

[300 m / (12.3 s + 12.2 s +12.3 s)] = 8.17 m/s.

Xun’s overall average velocity is [150 m / (6.2 s +6.5 s + 6.7 s)] = 7.1 m/s.

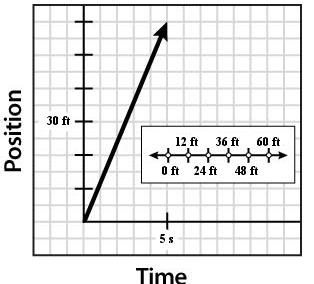
Atalanta is faster. The graphs shows a steeper slope for her set of time trials as well as for her overall average velocity.



PTS: 1 DIF: Bloom's Level 6 REF: pp. 38-40, 43

NAT: B.4

33. ANS:

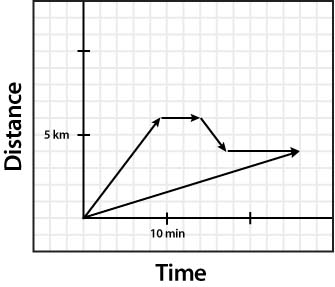


PTS: 1 DIF: Bloom's Level 5 REF: pp. 33, 38

NAT: B.4

34. ANS:

Mohinder’s total displacement is represented by the resultant vector of the legs of his journey.



The slope of the resultant is the average velocity:

4 km / 26 min 40 sec = 0.15 km/min = 9 km/hr

PTS: 1 DIF: Bloom's Level 5 REF: pp. 38-40, 43

NAT: B.4

35. ANS:

Now Mohinder has gone 9 km in 32.4 min. His average velocity for the excursion is

9 km/32 min = .27 km/min = 16.7 km/hr.

PTS: 1 DIF: Bloom's Level 5 REF: pp. 38-40, 43

NAT: B.4

36. ANS:

The skater’s displacement after 5 s is 30 m.

PTS: 1 DIF: Bloom's Level 4 REF: pp. 32-33, 36

NAT: B.4

37. ANS:

The position of the skater after 10 s = 60 m

The position of the skater after 13 s = 42 m

The skater reverses direction after 10 s. Therefore, the displacement of the skater between 10 s and 13 s = d = 42 m  60 m = 18 m

The negative sign shows that the direction of displacement in this case is negative, towards the starting point.

PTS: 1 DIF: Bloom's Level 5 REF: pp. 32-33, 36

NAT: B.4

38. ANS:

The position of the skater at 13 s = 42 m

The position of the skater at 17 s = 66 m

The skater reverses direction after 13 s. Therefore, the displacement of the skater between 13 s and 17 s = d = 66 m  42 m = 24 m

The positive sign shows that the direction of displacement in this case is positive, away from the starting point.

PTS: 1 DIF: Bloom's Level 6 REF: pp. 32-33, 36

NAT: B.4

39. ANS:



PTS: 1 DIF: Bloom’s Level 3 REF: Page 66

OBJ: 3.1.2 Relate velocity and acceleration to the motion of an object.

NAT: B.4 TOP: Relate velocity and acceleration to the motion of an object.

KEY: Relate velocity and acceleration MSC: 3

40. ANS:

It means that each second, the velocity of the object increases 9.8 m/s. So, the acceleration is 9.8 meters per second, per second.

PTS: 1 DIF: Bloom's Level 2 REF: p. 72

NAT: B.4

41. ANS:

Line E shows an object that is slowing down as it goes north. Then, it comes to a complete stop for an instant and reverses direction, speeding up as it goes south.

PTS: 1 DIF: Bloom's Level 4 REF: pp. 58-59, 62-63

NAT: B.4

42. ANS:

Line D represents velocity to the south with acceleration to the north that comes to a complete stop after a period of time.

PTS: 1 DIF: Bloom's Level 3 REF: pp. 58-59, 62-63

NAT: B.4

43. ANS:

The average acceleration is the rate of change in velocity over a measurable time interval.

The instantaneous acceleration is the rate of change in velocity at an instant in time.

PTS: 1 DIF: Bloom's Level 2 REF: p. 59

NAT: B.4

44. ANS:

Due to time dilation, Rene will age biologically more quickly on Earth than Captain Rocket does in space. Eventually, Rene will be biologically older than Captain Rocket, even though he was born after Captain Rocket.

PTS: 1 DIF: Bloom's Level 6 REF: p. 78

NAT: B.4

45. ANS:

Piano -- system

Gravity & upward pull of winch -- forces

Mass of Earth & winch -- agents

PTS: 1 DIF: Bloom’s Level 2 REF: p. 88

NAT: B.4

46. ANS:

Either you and your masses and pulley and string are all falling at the same velocity, or your pulley has jammed.

PTS: 1 DIF: Bloom’s Level 4 REF: p. 98

NAT: B.4

47. ANS:

An object in uniform circular motion has a constant speed, but its velocity keeps changing. Since velocity is a vector quantity, a change in direction indicates a change in velocity. Since the velocity changes, the object is said to be accelerating.

PTS: 1 DIF: Bloom’s Level 3 REF: Page 153

OBJ: 6.2.1 Explain why an object moving in a circle at constant speed is accelerated.

NAT: B.4 TOP: Explain why an object moving in a circle at constant speed is accelerated.

KEY: Uniform circular motion MSC: 2

48. ANS:

The dart that fell short of the fridge had a slower launch speed than the one that stuck. So it hit the ground before reaching the fridge.

PTS: 1 DIF: Bloom's Level 4 REF: pp. 148-150

NAT: B.4

49. ANS:

The horizontal motion of a projectile does not affect the vertical motion of a projectile. The vertical motion of a projectile does not affect the horizontal motion of a projectile.

PTS: 1 DIF: Bloom's Level 4 REF: pp. 148-149

NAT: B.4

50. ANS:

The range of a projectile depends upon the x-component of its initial velocity, vxi, and the time that the projectile is in the air: Range = vxit

The initial velocity in the x-direction is found by vxi = vi cos 

The time is determined by setting the y distance to zero: 0 = 0 + vyit  1/2 gt2 , where vyi = vi sin Solve for t:

0 = 0 + vyit  1/2 gt2

t = 2viy/g

vyi = vi sin 

t = 2(vi sin /g

Range = vxit

Range = vi cos  [2(vi sin /g]

2\*cos sin sin(2

Range = [(vi2sin(2)]/g.

For a given vi, the range has its maximum value when sin(2 has its maximum value of 1. This happens when 2= 90o, or = 45o.

PTS: 1 DIF: Bloom's Level 4 REF: p. 150

NAT: B.4

51. ANS:

Generally, the seats in those amusement park rides are covered in slippery vinyl. The coefficient of static friction between you and the ride is low, so your body naturally moves to the outside edge of the seat because it has a tendency to travel in a straight line forward as the ride spins.

PTS: 1 DIF: Bloom’s Level 5 REF: p. 156

NAT: B.4

52. ANS:

While va/c is the vector sum of the other two, it should also be interpreted as the velocity of object A in observer C’s frame of reference.

PTS: 1 DIF: Bloom’s Level 3 REF: p. 157

NAT: B.4

53. ANS:

Vector quantities have both magnitude and direction. When dealing with a one-dimensional vector, the direction of the vector can be designated by the sign of the number. So, the numbers being added or subtracted can be positive or negative. The sum of these numbers can be less than the two beginning numbers (also known as an “algebraic sum”). For scalar numbers, the numbers are always positive quantities, and the sum of two of these will always be greater than the parts (also known as an “arithmetic sum”).

PTS: 1 DIF: Bloom’s Level 5 REF: p. 35

NAT: B.4

54. ANS:

Yes, the velocity of one’s frame of reference does affect the velocities of objects observed from that frame of reference.

PTS: 1 DIF: Bloom’s Level 5 REF: pp. 152, 157

NAT: B.4

55. ANS:

Given that = v2/r = 42r/T2, the acceleration varies directly with the radius on a merry-go-round.

PTS: 1 DIF: Bloom’s Level 5 REF: p. 154

NAT: B.4

56. ANS:

The orbital period must be input in seconds  the Newton part of G translates into kg  m/s2, so the orbital period must be in seconds in order for the units to cancel correctly.

PTS: 1 DIF: Bloom’s Level 5 REF: p. 178

NAT: B.4

57. ANS:

The value of g on the planet’s surface would increase inversely proportionally to the square of the new radius. For example, if the radius were halved, g would be 4 times as great.

PTS: 1 DIF: Bloom’s Level 4 REF: p. 182

NAT: B.4

58. ANS:

The value of g on the planet’s surface would decrease inversely proportional to the square of the new radius. For example, if the radius were doubled, g would be divided by four.

PTS: 1 DIF: Bloom’s Level 4 REF: p. 182

NAT: B.4

59. ANS:

The speed would decrease as the satellite moves farther away.

PTS: 1 DIF: Bloom’s Level 5 REF: p. 180

NAT: B.4

60. ANS:

The period would increase (become longer) as the satellite moves farther away, because the speed would have decreased and the distance traveled would have increased.

PTS: 1 DIF: Bloom’s Level 5 REF: p. 180

NAT: B.4

61. ANS:

The weight of the object decreases as it moves farther from Earth.

PTS: 1 DIF: Bloom’s Level 3 REF: p. 182

NAT: B.4

62. ANS:

Based on Kepler’s second law, Earth must be closer to the Sun in the winter, because it is moving faster.

PTS: 1 DIF: Bloom’s Level 5 REF: p. 173

NAT: B.4

63. ANS:

The impulse on an object is equal to the object’s final momentum minus the object’s initial momentum.

PTS: 1 DIF: Bloom's Level 1 REF: p. 230

NAT: B.4

64. ANS:



PTS: 1 DIF: Bloom's Level 1 REF: p. 233

NAT: B.4

65. ANS:

It is not impulse that is changed by a seat belt, but force and time. A seat belt or air bag lengthens the time of the collision, thereby lessening the force.

PTS: 1 DIF: Bloom's Level 2 REF: p. 231

NAT: B.4

66. ANS:

The two asteroids can be considered a closed, isolated system because the acceleration from the faraway Sun is essentially the same on the two asteroids and all their fragments. They are in free-fall.

PTS: 1 DIF: Bloom's Level 2 REF: p. 236

NAT: B.4

67. ANS:

The small force is applied for a long time. Impulse is force multiplied by time.

PTS: 1 DIF: Bloom's Level 2 REF: p. 239

NAT: B.4

68. ANS:

The baseball’s horizontal acceleration is zero both before and after the collision, because its horizontal velocity is not changing during these times. The only time the baseball experiences a horizontal acceleration is during the collision. At this time, both the speed and direction of the baseball change.

PTS: 1 DIF: Bloom's Level 4 REF: p. 230

NAT: B.4

69. ANS:

The maximum force experienced by the ball is much greater than the average force experienced over the entire collision. For this collision, force is not constant.

PTS: 1 DIF: Bloom's Level 4 REF: p. 230

NAT: B.4

70. ANS:

Angular velocity depends on angular momentum and moment of inertia. Moment of inertia can change without a mass change, as when a figure skater pulls in his arms or a diver comes out of her spin.

PTS: 1 DIF: Bloom's Level 4 REF: p. 233

NAT: B.4

71. ANS:

This is only true in the special case of the skaters having the same mass.

PTS: 1 DIF: Bloom's Level 4 REF: p. 238

NAT: B.4

72. ANS:

The situation described is impossible. Momentum must be conserved in all directions. If the second ball moves from northeast to southwest, the first ball must be deflected from southeast to northwest.

PTS: 1 DIF: Bloom's Level 4 REF: p. 241

NAT: B.4

73. ANS:

The ice is not perfectly frictionless, and the ice skater can dig into the ice with his blades, thereby transferring momentum to the ice itself.

PTS: 1 DIF: Bloom's Level 4 REF: pp. 234, 243-244

NAT: B.4

74. ANS:

Since momentum equals mass times velocity, the momentum would equal zero.

PTS: 1 DIF: Bloom's Level 5 REF: p. 230

NAT: B.4

75. ANS:

In general, the farther away the mass is from the axis of rotation, the higher the moment of inertia.

PTS: 1 DIF: Bloom's Level 5 REF: pp. 233, 243-244

NAT: B.4

76. ANS:

The work-energy theorem says that the work done equals the change in kinetic energy.

PTS: 1 DIF: Bloom's Level 1 REF: pp. 258-259

NAT: B.5 | B.6

77. ANS:

Efficiency, e, equals either work output/work input times 100 or mechanical advantage/ideal mechanical advantage times 100.

PTS: 1 DIF: Bloom's Level 1 REF: p. 268

NAT: B.5 | B.6

78. ANS:

Since work = force x distance, the units are N · m, or kg m2/s2. The units for energy are joules. 1 N · m equals 1 joule.

PTS: 1 DIF: Bloom's Level 1 REF: p. 259

NAT: B.5 | B.6

79. ANS:

Mechanical advantage is equal to the resistance force divided by the effort force.

PTS: 1 DIF: Boom's Level 1 REF: p. 266

NAT: B.5 | B.6

80. ANS:

When work is done on an object, the kinetic energy of that object increases.

PTS: 1 DIF: Bloom's Level 2 REF: pp. 258-259

NAT: B.5 | B.6

81. ANS:

No, the box will not gain kinetic energy. The applied force is perpendicular to the surface.

PTS: 1 DIF: Bloom's Level 2 REF: pp. 258-259

NAT: B.5 | B.6

82. ANS:

The force needed to compress the spring is not constant over the entire distance. For a non-compressed spring, the force needed starts at zero and increases as the spring is compressed.

PTS: 1 DIF: Bloom's Level 4 REF: p. 263

NAT: B.5 | B.6

83. ANS:

No work is done, because displacement is zero.

PTS: 1 DIF: Bloom's Level 2 REF: p. 258

NAT: B.5 | B.6

84. ANS:

A screw is usually tapered at one end, allowing it to more easily enter a material like wood. In this way, the screw shares the properties of a wedge, allowing it to move into a material with less applied force. The threads of a screw allow it to move more easily into wood or another material. The screw must turn a greater distance, but less force is required. The threads of the screw are in this way like an inclined plane, wrapped around the shaft of the screw in a spiral.

PTS: 1 DIF: Bloom's Level 4 REF: p. 269

NAT: B.5 | B.6

85. ANS:

Power is work over time. Since I took less time to do the same work, I produced more power.

PTS: 1 DIF: Bloom's Level 2 REF: pp. 263, 265

NAT: B.5 | B.6

86. ANS:

The string does not do work on the ball. The force is always at right angles to the motion of the ball.

PTS: 1 DIF: Bloom's Level 4 REF: pp. 259-260

NAT: B.5 | B.6

87. ANS:

Yes, the figure skater has a type of kinetic energy called rotational kinetic energy. The figure skater did work to get herself spinning (or perhaps a partner did the work to begin her spin). That work was transformed into rotational kinetic energy.

PTS: 1 DIF: Bloom's Level 2 REF: p. 287

NAT: B.5 | B.6

88. ANS:

At any point along the path where the vertical distance is halfway between the top and the bottom, gravitational potential energy and kinetic energy will be equal.

PTS: 1 DIF: Bloom's Level 2 REF: p. 294

NAT: B.5 | B.6

89. ANS:

The basketball will bounce lower. Some momentum, and some energy, were transferred from the basketball to the tennis ball in the collision, leaving less for the basketball.

PTS: 1 DIF: Bloom's Level 4 REF: p. 297

NAT: B.5 | B.6

90. ANS:

The kinetic energy is dissipated as heat on the brake pads and shoes of the car’s wheels.

PTS: 1 DIF: Bloom's Level 2 REF: p. 295

NAT: B.5 | B.6

91. ANS:

The collision is inelastic. The kinetic energy of the moving snowballs was transformed into heat energy by the collision.

PTS: 1 DIF: Bloom's Level 2 REF: p. 295

NAT: B.5 | B.6

92. ANS:

Both gravitational potential energy and the resulting kinetic energy are smaller for objects dropped on the Moon as compared to objects dropped on Earth.

PTS: 1 DIF: Bloom's Level 6 REF: p. 289

NAT: B.5 | B.6

93. ANS:

Liquid C will boil first.

PTS: 1 DIF: Bloom's Level 3 REF: Page 318

OBJ: 12.1.3 Define specific heat and calculate heat transfer.

TOP: Define specific heat and calculate heat transfer. KEY: Specific heat

MSC: 3

94. ANS:

A tire burst is a sudden change and there is not much heat transfer. The expanding air does positive work. According to the first law of thermodynamics, this work causes an equal decrease in internal energy. The decrease in internal energy relates to a decrease in the average kinetic energy of the molecules and, therefore, the temperature.

PTS: 1 DIF: Bloom's Level 2 REF: Page 326

OBJ: 12.2.2 State the first and second laws of thermodynamics.

TOP: State the first and second laws of thermodynamics. KEY: First law of thermodynamics

MSC: 2

95. ANS:

The internal energy does not change in a cyclic process.

PTS: 1 DIF: Bloom's Level 2 REF: Page 326

OBJ: 12.2.2 State the first and second laws of thermodynamics.

TOP: State the first and second laws of thermodynamics. KEY: First law of thermodynamics

MSC: 2

96. ANS:

Endotherms regulate their body temperature by changing their metabolic rate to maintain a constant internal temperature. Ectotherms’ internal temperatures change to reflect the temperature of their environment.

PTS: 1 DIF: Bloom's Level 4 REF: p. 322

NAT: C.5

97. ANS:

These do not depend on temperature because they occur at a set temperature, either the melting point or boiling point respectively.

PTS: 1 DIF: Bloom's Level 6 REF: p. 323

NAT: B.2

98. ANS:

James is incorrect. The final temperature depends on the specific heat of the each substance. Since the silver has a lower specific heat, it will change in temperature more than the copper as thermal energy is exchanged.

PTS: 1 DIF: Bloom's Level 6 REF: pp. 315, 317-318

NAT: B.6

99. ANS:

In Hooke’s Law, F = kx. The sign is negative because the force of the spring is always opposite to the displacement of the spring.

PTS: 1 DIF: Bloom's Level 6 REF: p. 376

NAT: UCP.3

100. ANS:

Additional energy must be added to the oscillation of a wave at regular intervals. These intervals must coincide with the natural period of the oscillation in order for the amplitude to increase.

PTS: 1 DIF: Bloom's Level 4 REF: p. 380

NAT: B.6

101. ANS:

Because the reflected wave is inverted, the second spring is probably heavier and/or stiffer.

PTS: 1 DIF: Bloom's Level 5 REF: pp. 387-388

NAT: B.6

102. ANS:

Answers will vary. This situation will occur with these conditions:

stationary source, observer moves away

stationary observer, source moves away

observer and source are moving in opposite directions

PTS: 1 DIF: Bloom's Level 5 REF: pp. 407-408

NAT: B.6

103. ANS:

Each different type of instrument has a different series of harmonics that resonate at different frequencies and amplitudes. The combination of these harmonics produces the distinctive sounds of different instruments.

PTS: 1 DIF: Bloom's Level 4 REF: p. 417

NAT: B.6

104. ANS:

55°

PTS: 1 DIF: Bloom's Level 1 REF: Page 458

OBJ: 17.1.1 Explain the law of reflection. TOP: Explain the law of reflection.

KEY: Angle of incidence MSC: 1

NOT: The angle of incidence is the angle made by the incident ray with the normal to the reflecting surface at the point of incidence.

105. ANS:

27°

PTS: 1 DIF: Bloom's Level 2 REF: Page 458

OBJ: 17.1.1 Explain the law of reflection. TOP: Explain the law of reflection.

KEY: Angle of incidence MSC: 2

NOT: The angle of incidence is the angle made by the incident ray with the normal to the reflecting surface at the point of incidence. The angle of reflection is equal to the angle of incidence. By simple geometry, it can be shown that the angle between the wavefront and the reflecting surface is the same as the angle of incidence.

106. ANS:

Plane mirrors can be fixed on any two parallel sides of a room to give an illusion of greater size.

PTS: 1 DIF: Bloom's Level 2 REF: Page 462

OBJ: 17.1.3 Locate the images formed by plane mirrors.

TOP: Locate the images formed by plane mirrors. KEY: Plane mirror

MSC: 2

NOT: The image formed by a plane mirror is placed at a distance that is equal to the distance between the object and the mirror. This gives an illusion of greater depth.

107. ANS:

A convex mirror can be used as a rear view mirror, because it produces an upright image of objects regardless of position and offers a wide field of view.

PTS: 1 DIF: Bloom's Level 2 REF: Page 471

OBJ: 17.2.2 Describe properties and uses of curved mirrors.

TOP: Describe properties and uses of curved mirrors. KEY: Convex mirror

MSC: 3

NOT: Convex mirrors produce images that are smaller than the objects. This increases the field of view for observers.

108. ANS:

70°

PTS: 1 DIF: Bloom's Level 2 REF: Page 458

OBJ: 17.1.1 Explain the law of reflection. TOP: Explain the law of reflection.

KEY: Angle of incidence MSC: 2

NOT: The angle of incidence is the angle made by the incident ray with the normal to the reflecting surface at the point of incidence. The angle of reflection is equal to the angle of incidence.

109. ANS:

Convex mirrors only produce virtual images because the light rays reflecting off them always diverge.

PTS: 1 DIF: Bloom's Level 4 REF: p. 471

NAT: B.6

110. ANS:

A plane mirror will produce a virtual image that is the same size as the object and located as far away from the mirror as the object is.

PTS: 1 DIF: Bloom's Level 4 REF: p. 473

NAT: B.6

111. ANS:

The object should be placed between the focal point and the mirror in order to produce a virtual image.

PTS: 1 DIF: Bloom's Level 4 REF: p. 473

NAT: B.6

112. ANS:

This mirror will produce an image that is 2.5 times larger than the object, and the image will be inverted with respect to the object.

PTS: 1 DIF: Bloom's Level 4 REF: p. 468

NAT: UCP.3

113. ANS:

55°

PTS: 1 DIF: Bloom's Level 1 REF: Page 458

OBJ: 17.1.1 Explain the law of reflection. TOP: Explain the law of reflection.

KEY: Angle of incidence MSC: 1

NOT: The angle of incidence is the angle made by the incident ray with the normal to the reflecting surface at the point of incidence.

114. ANS:

The surface of the object should have multiple narrow faces so that very little light is reflected back to the observer.

PTS: 1 DIF: Bloom's Level 2 REF: Page 459

OBJ: 17.1.2 Distinguish between specular and diffuse reflection.

TOP: Distinguish between specular and diffuse reflection.

KEY: Specular reflection, Diffuse reflection MSC: 2

NOT: The surface of the object should have multiple narrow faces so that very little light is reflected back to the observer.

115. ANS:

27°

PTS: 1 DIF: Bloom's Level 2 REF: Page 458

OBJ: 17.1.1 Explain the law of reflection. TOP: Explain the law of reflection.

KEY: Angle of incidence MSC: 2

NOT: The angle of incidence is the angle made by the incident ray with the normal to the reflecting surface at the point of incidence. The angle of reflection is equal to the angle of incidence. By simple geometry, it can be shown that the angle between the wavefront and the reflecting surface is the same as the angle of incidence.

116. ANS:

A convex mirror can be used as a rear view mirror, because it produces an upright image of objects regardless of position and offers a wide field of view.

PTS: 1 DIF: Bloom's Level 2 REF: Page 471

OBJ: 17.2.2 Describe properties and uses of curved mirrors.

TOP: Describe properties and uses of curved mirrors. KEY: Convex mirror

MSC: 3

NOT: Convex mirrors produce images that are smaller than the objects. This increases the field of view for observers.

117. ANS:

70°

PTS: 1 DIF: Bloom's Level 2 REF: Page 458

OBJ: 17.1.1 Explain the law of reflection. TOP: Explain the law of reflection.

KEY: Angle of incidence MSC: 2

NOT: The angle of incidence is the angle made by the incident ray with the normal to the reflecting surface at the point of incidence. The angle of reflection is equal to the angle of incidence.

118. ANS:

A plane mirror will produce a virtual image that is the same size as the object and located as far away from the mirror as the object is.

PTS: 1 DIF: Bloom's Level 4 REF: p. 473

NAT: B.6

119. ANS:

The object should be placed between the focal point and the mirror in order to produce a virtual image.

PTS: 1 DIF: Bloom's Level 4 REF: p. 473

NAT: B.6

120. ANS:

This mirror will produce an image that is 2.5 times larger than the object, and the image will be inverted with respect to the object.

PTS: 1 DIF: Bloom's Level 4 REF: p. 468

NAT: UCP.3

**PROBLEM**

121. ANS:

532.5 m

PTS: 1 DIF: Bloom’s Level 3 REF: Page 65

OBJ: 3.2.1 Interpret position-time graphs for motion with constant acceleration.

NAT: B.4 TOP: Interpret position-time graphs for motion with constant acceleration.

KEY: Position-time graph MSC: 3

NOT: The area under the graph gives the distance traveled.

122. ANS:

1.10 s

PTS: 1 DIF: Bloom’s Level 3 REF: Page 72

OBJ: 3.3.2 Solve objects involving objects in free fall. NAT: B.4

TOP: Solve objects involving objects in free fall. KEY: Free fall

MSC: 3

NOT: The total time is the sum of the time taken by the ball to reach its topmost point and the time to come down from the topmost point to the ground.

123. ANS:



PTS: 1 DIF: Bloom’s Level 3 REF: Page 59

OBJ: 3.1.3 Create velocity-time graphs. NAT: B.4 TOP: Create velocity-time graphs.

KEY: Velocity-time graph MSC: 3

NOT: The velocity-time graph is a straight line making an acute angle with the positive x-axis for accelerated motion, a horizontal line for uniform motion, and a straight line making an obtuse angle with the positive x-axis for decelerated motion.

124. ANS:

9.1 m/s

PTS: 1 DIF: Bloom’s Level 3 REF: Page 72

OBJ: 3.3.1 Define acceleration due to gravity. NAT: B.4

TOP: Define acceleration due to gravity. KEY: Acceleration due to gravity

MSC: 3

NOT: Calculate the maximum height reached and then use the starting point as the highest point.

125. ANS:

The ball both begins and ends with zero displacement.

df = di + vitf + 1/2atf2

0 m = 0 + 25 m/s (t) + 1/2(9.8 m/s2)(t)2

25 m/s = 4.9 m/s2 t

t = 5.1 s

PTS: 1 DIF: Bloom's Level 4 REF: pp. 72-73

NAT: B.4

126. ANS:

The gazelle’s velocity is constant, so the acceleration is zero.

PTS: 1 DIF: Bloom's Level 4 REF: p. 59

NAT: B.4

127. ANS:

The time for the ball to travel up and stop = 0.14 s:

vf = vi + atf

0 = 1.4 m/s + (9.8 m/s2)(t)

t = 0.14 s

The ball takes the same amount of time to come back down. Thus one complete bounce cycle = 2  0.14 s = 0.28s

The number of bounces in 1 minute = 60 s/0.28 s = 214 bounces, assuming FiFi doesn’t drop the ball.

PTS: 1 DIF: Bloom's Level 5 REF: pp. 72-73

NAT: B.4

128. ANS:

300 bounces per minute = 5 bounces per second.

Each bounce takes 1/5 of a second = 0.20 seconds/bounce.

Each bounce has an upward and a downward motion, both of which are equal in time. So, the amount of time it takes the ball to go from zero velocity at the top of the bounce to hitting the racket is 0.10 s.

vf = vi + atf

0 = vi + (9.8 m/s2)(0.10s)

vi = 0.98 m/s

PTS: 1 DIF: Bloom's Level 6 REF: pp. 72-73

NAT: B.4

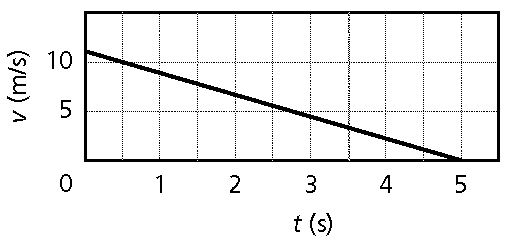
129. ANS:

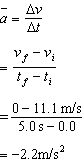
a. First convert the given values into similar units:

*v*i = 40.0 km/h

= 11.1 m/s

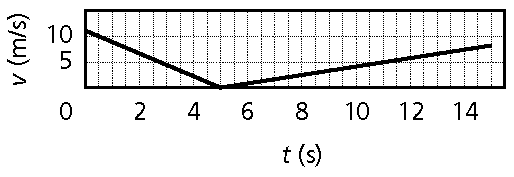
b.

****

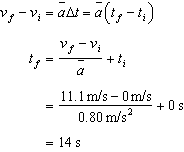
c. 

A negative value for the acceleration means that this truck is slowing down, because the sign of the acceleration is the opposite of the sign of the velocity.

d.

****

e. Using the stopping point at *t* = 5.0 s as our new initial value (*t*i = 0), the truck starts from rest (*v*i = 0) and accelerates to reach its original velocity (*v*f = 11.1 m/s).

f. Again using the stopping point at *t* = 5.0 s as our new initial value (*v*i = 0; *d*i = 0),



= 0 + (0)(14 s) +  (0.80 m/s2)(14 s)2

= 78 m

PTS: 1

130. ANS:

 N

PTS: 1 DIF: Bloom’s Level 3 REF: Page 87

OBJ: 4.1.2 Apply Newton's second law to solve problems. NAT: B.4

TOP: Apply Newton's second law to solve problems. KEY: Newton's second law

MSC: 3

NOT: Calculate the acceleration using the initial and final velocities. The product of the mass and acceleration gives the force.

131. ANS:

12.4 N

PTS: 1 DIF: Bloom’s Level 2 REF: Page 96

OBJ: 4.2.2 Differentiate between actual weight and apparent weight.

NAT: B.4 TOP: Differentiate between actual weight and apparent weight.

KEY: Apparent weight MSC: 3

NOT: Use Newton's second law to find the apparent weight of the block.

132. ANS:

a. Force exerted by the 2.1-kg block on the 3.5-kg block = 23 N

b. Force exerted by the floor of the elevator on the 3.5-kg block = 61 N

PTS: 1 DIF: Bloom’s Level 3 REF: Page 102

OBJ: 4.3.4 Determine the value of the normal force by applying Newton's second law.

NAT: B.4 TOP: Determine the value of the normal force by applying Newton's second law.

KEY: Normal force MSC: 3

NOT: Draw the free-body diagram for each block and then use Newton's second law to find the interaction forces.

133. ANS:

315 N + 145 N = 460 N

PTS: 1 DIF: Bloom’s Level 3 REF: p. 92

NAT: B.4

134. ANS:

The mass of the second sled = 4 times the mass of the first sled.

PTS: 1 DIF: Bloom’s Level 4 REF: p. 93

NAT: B.4

135. ANS:

The total tension is the sum total of the forces on the ropes.

Total force = (1.5 kg + 0.750 kg)  9.8 m/s2 = 22.05 N

There are 2 ropes, so each bears half the tension: 22.05 / 2 = 11.0 N each

PTS: 1 DIF: Bloom’s Level 4 REF: p. 105

NAT: B.4

136. ANS:

Fnet, 1 = M1 g  T = M2 a

Fnet, 2 = T  M2 g = M2 a

The accelerations are the same because the blocks are connected by a taut string.

(M1 + M2)a = (M1 g  T) + (T  M2 g)

a = g

a = 9.80 m/s2 

a = 9.80 m/s2 

a = 1.6 m/s2

PTS: 1 DIF: Bloom’s Level 6 REF: pp. 92-93, 105

NAT: B.4

137. ANS:

Recall that vf = vi + at

a = (vf -vi )/ t

a = (50 km/h 90 km/h) / 15 s

a = (40 km/h) / 15 s

a = (11.11 m/s) /15 s

a = 0.740 m/s2

F = ma

F = 450 kg (0.740 m/s2 ) = 330 N

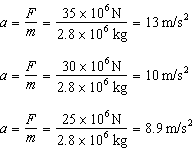
PTS: 1 DIF: Bloom’s Level 6 REF: pp. 79, 93

NAT: B.4

138. ANS:

a. To get off the launch pad, the acceleration upward must be greater than the acceleration downward due to the pull of gravity, namely

*a*thrust = *a*gravity = 9.80 m/s2.



Since the acceleration due to the forces of 35106 N and 30106 N is greater than *g*, either of these forces are sufficient to lift the rocket off the ground. However, the acceleration due to a force of 25106 N results in a net acceleration downward and does not move the rocket and its payload in a positive (upward) direction.

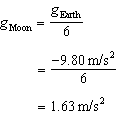
b. To balance the acceleration of gravity, the acceleration of the rocket should be equal and opposite, *a* = 19.80 m/s2.

*F = ma*

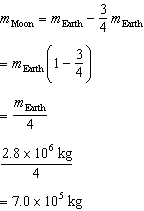
= (2.8106 kg)(9.80 m/s2)

= 27106 N

c. First, find the acceleration due to gravity on the Moon:



Next, calculate the mass of the rocket on the Moon after it has lost three-fourths of its mass due to fuel consumption:



To balance the acceleration of gravity, the acceleration of the rocket should be equal and opposite, *a* = +1.63 m/s2.

*F = ma*

= (7.0105 kg)(1.63 m/s2)

= 1.1106 N

PTS: 1

139. ANS:

The boat moves with 9.32 m/s at 29.8° to the river flow.

PTS: 1 DIF: Bloom’s Level 3 REF: Page 122

OBJ: 5.1.3 Solve for the sum of two or more vectors by adding the components of the vectors.

NAT: B.4

TOP: Solve for the sum of two or more vectors by adding the components of the vectors.

KEY: Sum of vectors MSC: 3

NOT: Resolve the velocity of the boat into components along and perpendicular to the river flow.

140. ANS:

98.7°

PTS: 1 DIF: Bloom’s Level 3 REF: Page 122

OBJ: 5.1.3 Solve for the sum of two or more vectors by adding the components of the vectors.

NAT: B.4

TOP: Solve for the sum of two or more vectors by adding the components of the vectors.

KEY: Sum of vectors MSC: 3

NOT: Resolve one of the vectors into components along and perpendicular to the second vector.

141. ANS:

6.42° south of east

PTS: 1 DIF: Bloom’s Level 3 REF: Page 122

OBJ: 5.1.3 Solve for the sum of two or more vectors by adding the components of the vectors.

NAT: B.4

TOP: Solve for the sum of two or more vectors by adding the components of the vectors.

KEY: Sum of vectors MSC: 3

NOT: Resolve the velocity of the plane in and perpendicular to the direction of the wind.

142. ANS:

Fp = k mg

= (0.20)(30.0 kg)(9.8 m/s2)

= 58.8 N

PTS: 1 DIF: Bloom’s Level 3 REF: pp. 126-131

NAT: B.4

143. ANS:

FN = Fg

= mg

= (30.0 kg)(9.8 m/s2)

= 294 N

PTS: 1 DIF: Bloom’s Level 3 REF: pp. 126-131

NAT: B.4

144. ANS:

Fgx = F (sin )

Fgx = 2891 N (sin 27.00)

Fgx = 1312 N

Fgy = F (cos)

Fgy = 2891 N (cos 27.00)

Fgy = 2576 N

PTS: 1 DIF: Bloom’s Level 4 REF: pp. 132-133

NAT: B.4

145. ANS:

Use the Pythagorean theorem, since the vectors are at right angles to one another:

c2 = a2 + b2

c2 = (3.4)2 + (2.6)2

c2 = (11.56)+ (6.76)

c2 = 18.32

c = 4.28 km

PTS: 1 DIF: Bloom’s Level 3 REF: p. 120

NAT: B.4

146. ANS:

 = tan-1 (Ry/Rx)

 = tan-1 (2.40/3.60)

 = tan-1 (.667)

 =  north of west

PTS: 1 DIF: Bloom’s Level 4 REF: p. 120

NAT: B.4

147. ANS:

The two displacements represent the x- and y-components of the resultant vector.

Use  = tan-1 (Ry/Rx)

 = tan-1 (Ry/Rx)

 = tan-1 (12.76/5.85)

 = tan-1 (2.181)

 =  south of east

PTS: 1 DIF: Bloom’s Level 4 REF: p. 123

NAT: B.4

148. ANS:

The force of gravity on the grasshopper is in the y-direction:

Fg = mg

Fg = (0.006 kg)(9.8 m/s2)

Fg = 0.0588 N

The stronger ant exerts a force in the y-direction and in the x-direction.

Fy = cos  (0.19 N)

Fy = cos 17.5 (0.19 N)

Fy = 0.181 N

Fx = sin  (0.19 N)

Fx = sin 17.5 (0.19 N)

Fx = 0.0571 N

The weaker ant exerts a force in the y-direction and in the x-direction.

Fy = cos  (0.15 N)

Fy = cos 17.5 (0.15 N)

Fy = 0.143 N

Fx = sin  (0.15 N)

Fx = sin 17.5 (0.15 N)

Fx = 0.045 N

Overall, the grasshopper has a force of 0.265 N upward in the y-direction, and 0.0121 N to the right in the x-direction.

PTS: 1 DIF: Bloom’s Level 5 REF: pp. 122-123, 131

NAT: B.4

149. ANS:

vf2 = vi2 + 2a(df  di)

Let vf  = 0 and df  di = d

0 = vi2 + 2a(d)

d = - vi2 / 2a

The weight in the y-direction = the normal force.

F = F = smg = ma

a = sg

d = - vi2 / (2(sg)

d = vi2 / (2(sg)

d = (120 m/s)2 / [2(9.8 m/s2)(0.71)]

d = 1000 m

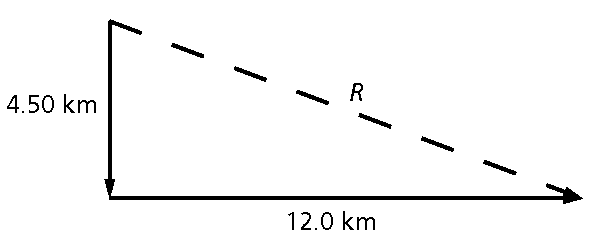
The cars had better have other mechanisms for stopping, besides the brakes.

PTS: 1 DIF: Bloom’s Level 6 REF: pp. 79, 126-127

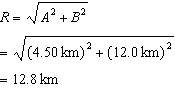
NAT: B.4

150. ANS:

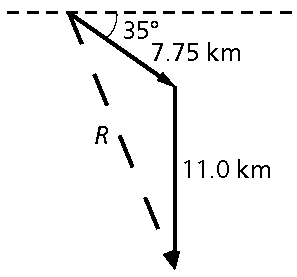
a. Draw the vectors of the distances walked:

****

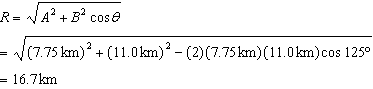
Because the two distance vectors are at right angles, *R*2 = *A*2 + *B*2



b. Draw the vectors again, using the new starting point as the origin:

****

Because the two distance vectors are not at right angles, *R*2 = *A*2 + *B*2 – 2*AB* cos 



c. The resultant vector may be calculated from the individual component vectors of the previous two days:

*R*1*x* = 12.0 km

*R*1*y* = – 4.50 km

*Ax* = *A* cos 1

*Ay* = –A sin 1

*Bx* = 0.00 km

*By* = – 11.0 km

*R*2*x* = *Ax* + *Bx*

= A cos 1 + *Bx*

= (7.75 km) cos 35.0º + 0.00 km

= 6.35 km

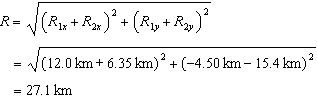
*R*2*y* = *Ay* + *By*

= –A sin 1 + (– 11.0 km)

= – (7.75 km) sin 35.0 – (11.0 km)

= – 15.4 km

*R*2 = (*R*1*x* + *R*2*x*)2 + (*R*1*y* + *R*2*y*)2



PTS: 1

151. ANS:

0.05 kg

PTS: 1 DIF: Bloom’s Level 3 REF: Page 154

OBJ: 6.2.3 Identify the force that causes centripetal acceleration.

NAT: B.4 TOP: Identify the force that causes centripetal acceleration.

KEY: Centripetal force MSC: 3

NOT: Find the velocity of the metallic object. The centripetal force for the metallic object is the product of the ratio and the centripetal force. Substitute this value in the relation F = mv^2/r to get the mass.

152. ANS:

The boat is traveling 3.20 m/s at 51.3 north of east.

PTS: 1 DIF: Bloom’s Level 2 REF: Page 157

OBJ: 6.3.2 Solve relative-velocity problems. NAT: B.4

TOP: Solve relative-velocity problems. KEY: Relative velocity

MSC: 3 NOT: Use the equation for the relative velocity of an object.

153. ANS:

36.0 m

PTS: 1 DIF: Bloom’s Level 3 REF: Page 157

OBJ: 6.3.2 Solve relative-velocity problems. NAT: B.4

TOP: Solve relative-velocity problems. KEY: Relative velocity

MSC: 3

NOT: While calculating the time taken to reach the other shore, divide the width of the river by the boat velocity. While calculating the distance, multiply the time by the river velocity.

154. ANS:

The time taken by boat A is 17.1 s.

The time taken by boat B is 14.7 s.

PTS: 1 DIF: Bloom’s Level 3 REF: Page 157

OBJ: 6.3.2 Solve relative-velocity problems. NAT: B.4

TOP: Solve relative-velocity problems. KEY: Relative velocity

MSC: 3 NOT: Use the equation for relative velocity of an object.

155. ANS:

vyi = vi(sini) = 20 m/s (sin 45) = 20 m/s (0.7071) = 14.14 m/s

vy = vyi + ayt

vy = vyi  gt

t = (vyi  vy) / g

y max = yi + vyit + 1/2 at2

y max = yi + vyi((vyi - vy) / g) + 1/2 g(vyi  vy / g)2

y max = 0 + 14.14 m/s(14.14 m/s  0 m/s / 9.8 m/s2) + 1/2 (9.8 m/s2)(14.14 m/s  0 m/s / 9.8 m/s2)2

y max = 14.14 m/s(14.14 m/s / 9.8 m/s2) + 1/2 (9.8 m/s2)(14.14 m/s / 9.8 m/s2)2

y max = 14.14 m/s(1.44 s) + 1/2 (9.8 m/s2)(1.44 s)2

y max = 20.36 m  10.16 m

y max = 10 m

PTS: 1 DIF: Bloom’s Level 3 REF: p. 150

NAT: B.4

156. ANS:

vyi = vi(sini) = 20 m/s (sin 45) = 20 m/s (0.7071) = 14.14 m/s

The range of a projectile depends upon the x-component of its initial velocity, vxi, and the time that the projectile is in the air: Range = vxit

The initial velocity in the x-direction is found by vxi = vi cos 

The time is determined by setting the y distance to zero: 0 = 0 + vyit  1/2 gt2 , where vyi = vi sin Solve for t:

0 = 0 + vyit  1/2 gt2

t = 2viy/g

vyi = vi sin 

t = 2(vi sin /g

Range = vxit

Range = vi cos  [2(vi sin /g]

2\*cos sin sin2

Range = (vi2sin2)/g.

R = (vi2sin20)/g

R = [(14.14 m/s)2sin2]/9.8 m/s2

R = [(199.9 m2/s2)(1)]/9.8 m/s2

R = 20.4 m

PTS: 1 DIF: Bloom’s Level 3 REF: p. 150

NAT: B.4

157. ANS:

vyi = vi(sini) = 12 m/s (sin 72) = 12 m/s (0.9510) = 11.4 m/s

vy = vyi + ayt

vy = vyi  gt

t = (vyi  vy) / g

y max = yi + vyit + 1/2 at2

y max = yi + vyi((vyi  vy) / g) + 1/2 g(vyi  vy / g)2

y max = 0 + 11.4 m/s(11.4 m/s0 m/s / 9.8 m/s2) + 1/2 (9.8 m/s2)(11.4 m/s  0 m/s / 9.8 m/s2)2

y max = 11.4 m/s(11.4 m/s / 9.8 m/s2) + 1/2 (9.8 m/s2)(11.4 m/s / 9.8 m/s2)2

y max = 11.4 m/s(1.16 s) + 1/2 (9.8 m/s2)(1.16 s)2

y max = 13.22 m  5.68 m

y max = 7.5 m

PTS: 1 DIF: Bloom’s Level 3 REF: p. 150

NAT: B.4

158. ANS:

vyi = vi(sini) = 12 m/s (sin 72) = 12 m/s (0.9511) = 11.4 m/s

yf = yi + vyit +  at2

0 m = 0 m + vyit   gt2

0 m = vyit  gt2

0 m = t(vyi gt)

Either t = 0 or vyi gt = 0

We care about the point when t > 0.

vyi gt = 0 or 11.4  4.9t = 0

t = 2.33 s

PTS: 1 DIF: Bloom’s Level 3 REF: p. 150

NAT: B.4

159. ANS:

v = (2r)/T

110 cm/s = [(217.6 cm

T = [(217.6 cm110 cm/s)

T = 1.00 s

PTS: 1 DIF: Bloom’s Level 5 REF: p. 154

NAT: B.4

160. ANS:











PTS: 1 DIF: Bloom's Level 4 REF: p. 154

NAT: B.4

161. ANS:

Relative motion is the algebraic sum of the quantities involved. Let the ship be moving in the positive direction.

80.0 km/hr + (6.5 km/hr) = 73.5 km/hr in the direction of the ship.

PTS: 1 DIF: Bloom's Level 4 REF: p. 157

NAT: B.4

162. ANS:

3.0 m/s + (7.0 m/s) = 4.0 m/s, or 4.0 m/s toward the back of the ship.

PTS: 1 DIF: Bloom's Level 2 REF: p. 157

NAT: B.4

163. ANS:

13.0 m/s + (4.0 m/s) = 9.0 m/s, or 9 m/s east (in the same direction as the train).

PTS: 1 DIF: Bloom's Level 2 REF: p. 157

NAT: B.4

164. ANS:

Because the velocities are at right angles to each other, use the Pythagorean Theorem to find the magnitude of the relative velocity:

(v p/w)2 = (v)2 +(v p/s)2

(v p/w)2 = (3.0 m/s)2 +(9.0 m/s)2

(v p/w)2 = (9.0 m2/s2) +(81.0 m2/s2)

(v p/w)2 = (90.0 m2/s2)

v p/w = 9.5 m/s

Find the angle of the puck’s motion:

= tan-1(v p/s / v s/w)

= tan-1(9.0 m/s / 3.0 m/s)

=  east of north

PTS: 1 DIF: Bloom's Level 4 REF: p. 157

NAT: B.4

165. ANS:

Find the velocities for each rider.

Inside rider (1):





v1 = 0.35 m/s

Outside rider (2):





v2 = 0.70 m/s

The outside rider is moving twice as fast as the inside rider, or is going 0.35 m/s faster.

PTS: 1 DIF: Bloom’s Level 6 REF: p. 154

NAT: B.4

166. ANS:

The only force acting on the paintball to cause it to hit the ground is gravity. The time that it will take for a fired paintball to hit the ground is the same as if it were dropped vertically from the same height. There is no initial velocity downwards.

df = di + vitf + 1/2atf2

1.75 m = 0 m + 0(t) + 1/2(9.8 m/s2)(t)2

t = 0.60 s

PTS: 1 DIF: Bloom's Level 4 REF: pp. 148-149

NAT: B.4

167. ANS:

 N

PTS: 1 DIF: Bloom’s Level 3 REF: Page 177 | Page 178

OBJ: 7.1.3 Describe the importance of Cavendish's experiment.

NAT: B.4 TOP: Describe the importance of Cavendish's experiment.

KEY: Gravitational force MSC: 3

NOT: Use the mathematical form of Newton's law of gravitation.

168. ANS:

8.9 m/s2

PTS: 1 DIF: Bloom’s Level 3 REF: Page 177 | Page 178

OBJ: 7.1.3 Describe the importance of Cavendish's experiment.

NAT: B.4 TOP: Describe the importance of Cavendish's experiment.

KEY: Acceleration due to gravity MSC: 3

NOT: Acceleration due to gravity is directly proportional to the mass of the planet and inversely proportional to the square of the planet's radius.

169. ANS:

220 m/s2

PTS: 1 DIF: Bloom’s Level 3 REF: Page 177 | Page 178

OBJ: 7.1.3 Describe the importance of Cavendish's experiment.

NAT: B.4 TOP: Describe the importance of Cavendish's experiment.

KEY: Acceleration due to gravity MSC: 3

NOT: Acceleration due to gravity is directly proportional to the mass of the planet and inversely proportional to the square of the planet's radius.

170. ANS:

1400 km

PTS: 1 DIF: Bloom’s Level 3 REF: Page 182 | Page 183

OBJ: 7.2.3 Describe gravitational fields. NAT: B.4 TOP: Describe gravitational fields.

KEY: Gravitational field MSC: 3

NOT: The gravitational intensity of a planet is inversely proportional to the square of the distance from Earth's center.

171. ANS:

7.6 h  (60 min / 1 h)  (60 sec / 1 min) = 2.7  104 seconds

PTS: 1 DIF: Bloom’s Level 3 REF: p. 173

NAT: B.4

172. ANS:

30.35 h  (60 min / 1 h)  (60 sec / 1 min) = 1.1  10-5 seconds

PTS: 1 DIF: Bloom’s Level 3 REF: p. 173

NAT: B.4

173. ANS:

G = N×m2/kg2

1 N = 1 kg × m/s2

G = (kg × m/s2)m2/kg2

G = (kg × m3/s2)/ kg2

G = (kg m3)/ (kg2s2)

G = m3 / (kg s2)

PTS: 1 DIF: Bloom’s Level 4 REF: pp. 177-178

NAT: B.4

174. ANS:

Fg = G[m1m2/r2]

Fg = 6.67  10-11[(0.300 kg)(0.300 kg)/(0.75 m)2]

Fg = 6.67  10-11 N m2/kg2[(0.0900 kg2)/(0.5625 m2)]

Fg = 6.67  10-11 N m2/kg2[(0.16 kg2/m2]

Fg = 1.1  10-11 N

PTS: 1 DIF: Bloom’s Level 3 REF: p. 175

NAT: B.4

175. ANS:

r = h + rM

h = 150 km = 150,000 m

r = 150,000 m + 3.396  106 m = 3.55  106 m

v2 = GmE/r

v2 = (6.67  10-11 N m2/kg2)(6.4185  1023 kg) / (3.55  106 m)

v2 = 1.21  107 m2/s2

v = 3500 m/s

PTS: 1 DIF: Bloom’s Level 4 REF: p. 180

NAT: B.4

176. ANS:

m = 1950 g = 1.950 kg

r = 1/2 d = 1/2 (8 cm) = 4 cm = 0.04 m

g = Gm/r2

g = (6.67  10-11 N m2/kg2)(1.950 kg) / (0.04 m)2

g = (1.30  10-10 m3/s2) / (0.04 m)2

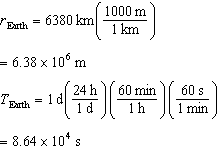
g = 1.63  10-11 N/kg

PTS: 1 DIF: Bloom’s Level 3 REF: pp. 182-183

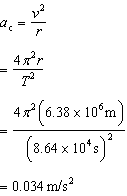
NAT: B.4

177. ANS:

a. First, convert all known values to standard units,



From the equation for centripetal acceleration,

**

*g*equator = g + *a*c

= 9.80 m/s2 + 0.034 m/s2

= 9.83 m/s2

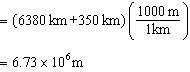
b. No; the poles of Earth rest on the axis of rotation, so *r* = 0:



We are able to use the correct value of 9.80 m/s2 in our calculations because the frame of reference of our laboratory also experiences the same force due to centripetal acceleration as a falling object. Any force due to centripetal acceleration is experienced equally by both object and observer and so may be neglected.

c. The radius of the orbit of the space shuttle is

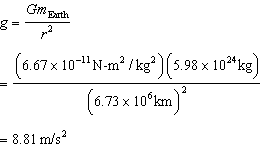
*r* = *r*Earth + *h*



Using Newton’s law of universal gravitation,



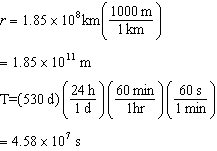
As you can see, the mass of the object may be removed from the equation, and the value of *g* is truly independent of the mass:



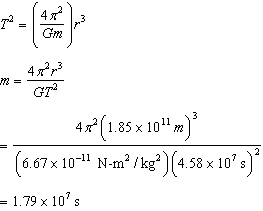
PTS: 1

178. ANS:

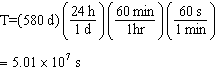
a. First, convert all known values to standard units:



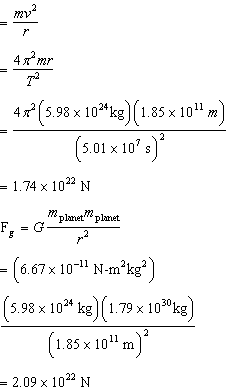
Using Kepler’s third law of planetary motion,



b. For an orbit of 580 days,



*F*c = *ma*c



Since *F*g  *F*c, the gravitational force will eventually overcome the centripetal force, causing the orbit to decay and the planet to collide with the object. A period of 580 days is unstable under these conditions.

PTS: 1

179. ANS:

**  N

**  N

PTS: 1 DIF: Bloom's Level 3 REF: Page 230

OBJ: 9.1.2 Determine the impulse given to an object. NAT: B.4

TOP: Determine the impulse given to an object. KEY: Impulse

MSC: 3

NOT: Apply the impulse-momentum theorem to obtain the force needed to stop the vehicle.

180. ANS:

 N

PTS: 1 DIF: Bloom's Level 3 REF: Page 230

OBJ: 9.1.2 Determine the impulse given to an object. NAT: B.4

TOP: Determine the impulse given to an object. KEY: Impulse

MSC: 3

NOT: Apply the impulse-momentum theorem to obtain the force the bat exerts on the ball.

181. ANS:

0.014 s

PTS: 1 DIF: Bloom's Level 3 REF: Page 230

OBJ: 9.1.2 Determine the impulse given to an object. NAT: B.4

TOP: Determine the impulse given to an object. KEY: Impulse

MSC: 3

NOT: Apply the impulse-momentum theorem to obtain the time the ball is in contact with the club.

182. ANS:

9.72 m/s

PTS: 1 DIF: Bloom's Level 3 REF: Page 230

OBJ: 9.1.2 Determine the impulse given to an object. NAT: B.4

TOP: Determine the impulse given to an object. KEY: Impulse

MSC: 3 NOT: Apply the impulse-momentum theorem to obtain the change in velocity.

183. ANS:

0.0298 m/s

PTS: 1 DIF: Bloom's Level 3 REF: Page 240

OBJ: 9.2.3 Solve conservation of momentum problems.

TOP: Solve conservation of momentum problems. KEY: Conservation of momentum

MSC: 3 NOT: Apply the law of conservation of momentum.

184. ANS:

 N

PTS: 1 DIF: Bloom's Level 3 REF: Page 237

OBJ: 9.2.1 Relate Newton's third law to conservation of momentum.

TOP: Relate Newton's third law to conservation of momentum. KEY: Conservation of momentum

MSC: 3 NOT: Apply the law of conservation of momentum.

185. ANS:

12 kg m/s

PTS: 1 DIF: Bloom's Level 3 REF: p. 230

NAT: B.4

186. ANS:

0.15 m/s

PTS: 1 DIF: Bloom's Level 3 REF: pp. 236-237

NAT: B.4

187. ANS:

5.0 m/s, 89 degrees from the angle of the ball.

PTS: 1 DIF: Bloom's Level 3 REF: p. 241

NAT: B.4

188. ANS:

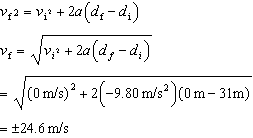
1.2 m/s

PTS: 1 DIF: Bloom's Level 3 REF: pp. 236-237

NAT: B.4

189. ANS:

a. To find the final velocity of the falling stunt person,



Since the stunt person is falling in the downward direction, we take the negative value as our velocity, *v*f = –24.6 m/s.

*p*f = *mv*f

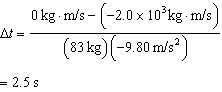
= (83 kg)(–24.6 m/s)

= –2.0103 kg·m/s

b. *F**t* = pf  p1

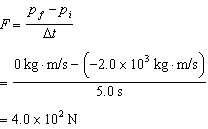


With the stunt person finishing at rest, *v*f = 0 m/s and *p*f = 0 kgm/s:



c. The force on the stunt person’s body is the force exerted by the air bag:

*F**t* = *p*f  *p*i



When he falls, the stunt person exerts a force equal to his own body weight:F = *mg* = (83 kg)(9.80 m/s2) = 813 N

Yes, this air bag is safe for the stunt person to use. The force experienced by the stunt person is less than his own body weight.

d. *F**t* = *p*f  *p*i = *mv*f  *mv*i

*mg**t* = *mv*f  *mv*i = *mv*f

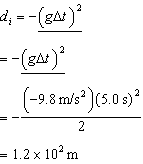
*v*i = 0 m/s

*v*f = *g**t*

Substitute this value for *v*f —along with the values *v*i = 0 m/s, *d*f = 0 m, and a = g— into our original velocity equation.

*v*f2 = *v*i2 + 2a(*d*f  *d*i)

(g*t*)2 = 2g(di)



PTS: 1

190. ANS:

 J

PTS: 1 DIF: Bloom's Level 3 REF: Page 260

OBJ: 10.1.2 Calculate work. TOP: Calculate work.

KEY: Work MSC: 3

NOT: Use the equation for work when a constant force is exerted in the same direction as the object's displacement. Since the object is moving against gravity, find the height of the object and substitute in the equation.

191. ANS:

 W

PTS: 1 DIF: Bloom's Level 3 REF: Page 263

OBJ: 10.1.3 Calculate the power used. TOP: Calculate the power used.

KEY: Power MSC: 3

NOT: Work is equal to the change in kinetic energy. Power is equal to the work done divided by the time taken to do the work.

192. ANS:

18,000 joules

PTS: 1 DIF: Bloom's Level 3 REF: p. 258

NAT: B.5 | B.6

193. ANS:

9.4  105 J

PTS: 1 DIF: Bloom's Level 3 REF: pp. 259-260

NAT: B.5 | B.6

194. ANS:

490 watts

PTS: 1 DIF: Bloom's Level 3 REF: pp. 263, 265

NAT: B.5 | B.6

195. ANS:

15 m

PTS: 1 DIF: Bloom's Level 3 REF: pp. 266-267

NAT: B.5 | B.6

196. ANS:

90 J

PTS: 1 DIF: Bloom's Level 3 REF: p. 268

NAT: B.5 | B.6

197. ANS:



PTS: 1 DIF: Bloom's Level 2 REF: Page 285

OBJ: 11.1.3 Determine the gravitational potential energy of a system.

TOP: Determine the gravitational potential energy of a system. KEY: Gravitational potential energy

MSC: 3

NOT: The gravitational potential energy of an object is equal to the product of its mass, the acceleration due to gravity, and its height from the reference level.

198. ANS:

27 J

PTS: 1 DIF: Bloom's Level 2 REF: Page 285

OBJ: 11.1.3 Determine the gravitational potential energy of a system.

TOP: Determine the gravitational potential energy of a system. KEY: Gravitational potential energy

MSC: 3

NOT: The gravitational potential energy of an object is equal to the product of its mass, the acceleration due to gravity, and its height from the reference level.

199. ANS:

 m

PTS: 1 DIF: Bloom's Level 3 REF: Page 293

OBJ: 11.2.2 Analyze collisions to find the change in kinetic energy.

TOP: Analyze collisions to find the change in kinetic energy.

KEY: Collisions, Change in kinetic energy MSC: 3

NOT: The principle of conservation of momentum can be used to find the final velocity of the block. The kinetic energy of the block is used in doing work against friction.

200. ANS:

1.0  105 J

PTS: 1 REF: pp. 286-287 NAT: B.5 | B.6

201. ANS:

Initial kinetic energy of the pod = 2.0  104 J

Final kinetic energy of the pod = 1.2  105 J

Work done to increase speed = 1.0  105 J

PTS: 1 DIF: Bloom's Level 3 REF: pp. 286-287

NAT: B.5 | B.6

202. ANS:

1.5 m. Since mass appears in both the potential energy equation and the kinetic energy equation, it cancels out. A bowling ball of any mass will perform the same way, as long as air resistance and friction can be ignored.

PTS: 1 DIF: Bloom's Level 3 REF: pp. 294-295

NAT: B.5 | B.6

203. ANS:

a) initial KE = 880 J

b) final speed = 0.41 m/s

c) final KE = 83 J

d) 91 %

PTS: 1 DIF: Bloom's Level 3 REF: pp. 287, 298

NAT: B.5 | B.6

204. ANS:

a) 61 m/s, or 61 m/s in the other direction.

b) 4.9  109 %

c) One possible source for all this additional kinetic energy is rest energy, given by E=m0c2.

PTS: 1 DIF: Bloom's Level 5 REF: pp. 287, 292, 294

NAT: B.5 | B.6

205. ANS:

From the law of conservation of energy,

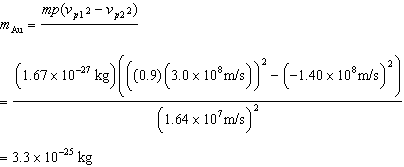
*KE*p1 + *KE*Au1 = *KE*p2 + *KE*Au2

mpvp12 1 mAuvAu12 5 mpvp22 1 mAuvAu22

Since the gold atom starts from rest, *v*Au1 = 0 m/s. Substituting and simplifying,

*m*p*v*p12 = *m*p*v*p22 + *m*Au*v*Au2

*m*Au*v*Au2 = *m*p(*v*p12  *v*p22)

**

PTS: 1

206. ANS:

2.2  103 J/kgK

PTS: 1 DIF: Bloom's Level 3 REF: Page 318

OBJ: 12.1.3 Define specific heat and calculate heat transfer.

TOP: Define specific heat and calculate heat transfer. KEY: Specific heat

MSC: 3

NOT: The heat lost by the aluminum piece is equal to the heat gained by the calorimeter and the paraffin in it.

207. ANS:

446 K

PTS: 1 DIF: Bloom's Level 1 REF: Page 316

TOP: Distinguish different temperature scales. KEY: Temperature scales

MSC: 1 NOT: Convert the temperature from Celsius to kelvins.

208. ANS:

40%

PTS: 1 DIF: Bloom's Level 2 REF: Page 326

OBJ: 12.2.2 State the first and second laws of thermodynamics.

TOP: State the first and second laws of thermodynamics. KEY: Efficiency of heat engine

MSC: 2

NOT: The efficiency of a heat engine is equal to the ratio of the work done by the engine to the heat input.

209. ANS:

Work done by the gas = 0 J

Change in internal energy = – 100 J

PTS: 1 DIF: Bloom's Level 2 REF: Page 328

OBJ: 12.2.3 Distinguish between heat and work. TOP: Distinguish between heat and work.

KEY: First law of thermodynamics MSC: 2

NOT: The gas does no work because there is no change in volume. The change in internal energy can be found using the first law of thermodynamics.

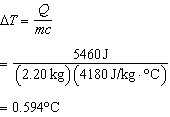
210. ANS:

a. *W = mgh*

= (1826 kg)(9.80 m/s2)(0.305 m)

= 5460 J

b. *Q = mc**T*



PTS: 1

211. ANS:

376%

PTS: 1 DIF: Bloom's Level 3 REF: Page 375

OBJ: 14.1.2 Determine the energy stored in an elastic spring.

TOP: Determine the energy stored in an elastic spring. KEY: Energy in elastic spring

MSC: 3

NOT: The increase in potential energy is one half times the spring constant times the difference between the squares of the final and initial extensions. The percent increase is equal to 100 times the increase in energy divided by the initial energy.

212. ANS:

Frequency = 0.400 Hz

Wavelength = 30.0 m

PTS: 1 DIF: Bloom's Level 3 REF: Page 381

OBJ: 14.2.3 Relate wave speed, wavelength, and frequency.;

TOP: Relate wave speed, wavelength, and frequency.;

KEY: Wave speed, Wavelength, Frequency MSC: 3

NOT: The graph can be used to find the time period of the wave. The reciprocal of time period is the frequency of the wave. The wavelength is equal to the velocity divided by the frequency.

213. ANS:

T = 2(*l*/g)1/2

4.7 s = 2(*l*/9.8 m/s2)1/2

4.7/(2(*l*/9.8 m/s2)1/2

0.74803 = (*l*/9.8 m/s2)1/2

0.55955 = *l*/9.8 m/s2

*l* = 5.5 meters

PTS: 1 DIF: Bloom's Level 5 REF: p. 379

NAT: UCP.3

214. ANS:

8.72 m/s

PTS: 1 DIF: Bloom's Level 3 REF: Page 403 | Page 407

OBJ: 15.1.3 Identify some applications of the Doppler effect.

TOP: Identify some applications of the Doppler effect. KEY: Doppler effect

MSC: 3

NOT: When a sound source moves away from a stationary observer, the wavelength of sound increases. The apparent frequency is lower than the true frequency.

215. ANS:

v = f

v = (13.9 m)(256 Hz)

v = 3558.4 m/s

This is most likely to be copper.

PTS: 1 DIF: Bloom's Level 6 REF: pp. 404-405

NAT: UCP.3

216. ANS:

A 2.5-cm image is formed 15 cm in front of the mirror.

PTS: 1 DIF: Bloom's Level 2 REF: Page 468

OBJ: 17.2.3 Determine the locations and sizes of curved mirror images.

TOP: Determine the locations and sizes of curved mirror images.

KEY: Concave mirror MSC: 2

NOT: Use the mirror formula to find the image distance and then calculate the magnification.

217. ANS:

81 cm

PTS: 1 DIF: Bloom's Level 1 REF: Page 462

OBJ: 17.1.3 Locate the images formed by plane mirrors.

TOP: Locate the images formed by plane mirrors. KEY: Plane mirror

MSC: 1

NOT: The minimum height of a plane mirror required for a boy to view himself from head to toe is half the boy's height.

218. ANS:

120°

PTS: 1 DIF: Bloom's Level 3 REF: Page 461

OBJ: 17.1.3 Locate the images formed by plane mirrors.

TOP: Locate the images formed by plane mirrors. KEY: Plane mirror

MSC: 2 NOT: Use the laws of reflection.

219. ANS:

A 5.0-cm image is formed 20 cm in front of the mirror.

PTS: 1 DIF: Bloom's Level 2 REF: Page 468

OBJ: 17.2.3 Determine the locations and sizes of curved mirror images.

TOP: Determine the locations and sizes of curved mirror images.

KEY: Concave mirror MSC: 2

NOT: Use the mirror formula to find the image distance and then calculate the magnification.

220. ANS:

Step 1: Find the focal length. f = r/2 so f = 15.0/2 or 7.5 cm

Step 2: Find the image distance using the mirror equation

di = (fdo)/(dof)

di = (7.5 cm)(20 cm)/(20 cm7.5 cm) = 12.0 cm

Step 3: Use the magnification relationship to find the image height

hi = -diho/do = (-12.0 cm)(1.5 cm) / 20 cm = -0.9 cm

The image will be real, inverted, and smaller (0.9 cm tall), located 12 cm in front of the mirror.

PTS: 1 DIF: Bloom's Level 5 REF: p. 467

NAT: UCP.3

221. ANS:

do = -diho/hi = -(-12)(5.0)/(8.0) = 7.5 cm

Place the object 7.5 cm in front of the mirror.

PTS: 1 DIF: Bloom's Level 5 REF: p. 467

NAT: UCP.3

222. ANS:

Step 1: Find the focal length. f = r/2 so f = 34.0/2 or 17.0 cm

Step 2: Find the image distance using the mirror equation

di = (fdo)/(dof)

di = (17.0 cm)(50.0 cm)/(50.0 cm – 17.0 cm) = 25.8 cm

Step 3: Use the magnification relationship to find the image height

hi = -diho/do = -(-25.8 cm)(20.0 cm) / 50.0 cm = 10.3 cm

The image will be virtual, located 25.8 cm behind the mirror, and will be 10.3 cm tall.

PTS: 1 DIF: Bloom's Level 5 REF: pp. 467-468

NAT: UCP.3

223. ANS:

a. The mirror must be concave, because only a concave mirror can produce magnified images.

b. First find the image distance using the magnification:

Because the image is inverted, the real magnification value is 2.5.

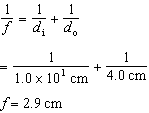


*d*i = *md*o

= (2.5)(4.0 cm)

= +1.0101 cm

Then calculate the focal length:



The radius of curvature is therefore given by:

*r* = 2*f* = 2(2.9 cm) = 5.8 cm

Image is enlarged and inverted only if *r*  do  , which is true for this value of *r*.

PTS: 1

224. ANS:

A 2.5-cm image is formed 15 cm in front of the mirror.

PTS: 1 DIF: Bloom's Level 2 REF: Page 468

OBJ: 17.2.3 Determine the locations and sizes of curved mirror images.

TOP: Determine the locations and sizes of curved mirror images.

KEY: Concave mirror MSC: 2

NOT: Use the mirror formula to find the image distance and then calculate the magnification.

225. ANS:

81 cm

PTS: 1 DIF: Bloom's Level 1 REF: Page 462

OBJ: 17.1.3 Locate the images formed by plane mirrors.

TOP: Locate the images formed by plane mirrors. KEY: Plane mirror

MSC: 1

NOT: The minimum height of a plane mirror required for a boy to view himself from head to toe is half the boy's height.

226. ANS:

A 10-cm image is formed 10 cm behind the mirror.

PTS: 1 DIF: Bloom's Level 2 REF: Page 468

OBJ: 17.2.3 Determine the locations and sizes of curved mirror images.

TOP: Determine the locations and sizes of curved mirror images.

KEY: Concave mirror MSC: 2

NOT: Use the mirror formula to find the image distance and then calculate the magnification.

227. ANS:

10°

PTS: 1 DIF: Bloom's Level 2 REF: Page 461

OBJ: 17.1.3 Locate the images formed by plane mirrors.

TOP: Locate the images formed by plane mirrors. KEY: Plane mirror

MSC: 2 NOT: Use the laws of reflection.

228. ANS:

A 1.7-cm image is formed 6.67 cm behind the mirror.

PTS: 1 DIF: Bloom's Level 2 REF: Page 468

OBJ: 17.2.3 Determine the locations and sizes of curved mirror images.

TOP: Determine the locations and sizes of curved mirror images.

KEY: Convex mirror MSC: 2

NOT: Use the mirror formula to find the image distance and then calculate the magnification.

229. ANS:

The length of the image of the rod is 20.80 cm.

PTS: 1 DIF: Bloom's Level 2 REF: Page 468

OBJ: 17.2.3 Determine the locations and sizes of curved mirror images.

TOP: Determine the locations and sizes of curved mirror images.

KEY: Convex mirror MSC: 2

NOT: Use the mirror formula to find the location of the image of each end of the rod and then subtract the image distances to get the length of the image.

230. ANS:

Step 1: Find the focal length. f = r/2 so f = 34.0/2 or 17.0 cm

Step 2: Find the image distance using the mirror equation

di = (fdo)/(dof)

di = (17.0 cm)(50.0 cm)/(50.0 cm – 17.0 cm) = 25.8 cm

Step 3: Use the magnification relationship to find the image height

hi = -diho/do = -(-25.8 cm)(20.0 cm) / 50.0 cm = 10.3 cm

The image will be virtual, located 25.8 cm behind the mirror, and will be 10.3 cm tall.

PTS: 1 DIF: Bloom's Level 5 REF: pp. 467-468

NAT: UCP.3

**ESSAY**

231. ANS:

a. Thomas had been cycling for 1.0 s, when Anna started cycling.

b. Anna crosses Thomas at a point 12.0 m from the starting point.

c. Displacement of Thomas after 5.0 s = 20.0 m – 0.0 m = 20.0 m.

Displacement of Anna after 5.0 s = 24.0 m – 0.0 m = 24.0 m.

The difference in their positions after 5.0 s is 4.0 m with Anna being ahead.

PTS: 1 DIF: Bloom’s Level 3 REF: Page 42

OBJ: 2.3.2 Use a position-time graph to interpret an object's position or displacement.

NAT: B.4 TOP: Use a position-time graph to interpret an object's position or displacement.

KEY: Position-time graph, Instantaneous position MSC: 2

232. ANS:

The stroboscope must be flashing at a constant time interval. The bursts of light illuminate the moving object and show its displacement for each time interval. To translate this picture into a particle-model motion diagram, let a point represent the object as it moves, and let each flash of the stroboscope represent one time interval. If the object is accelerating in a constant, positive way, the distances between the points will increase with each time interval. If there is zero acceleration, the distances between the points will remain constant with each time interval.

PTS: 1 DIF: Bloom's Level 4 REF: p. 60

NAT: B.4

233. ANS:

Broken glass can injure a person through two mechanisms: Weight and inertia. Large, heavy shards of broken glass can fall like guillotines. In order to stop this heavy, accelerating mass, a force would need to be applied in the opposite direction. If the force is applied by the limb of a person, it is much more likely that the person will lose the limb than the glass will be stopped.

When a character jumps or drives a motorcycle through a window, the shards of glass will tend to stay in place due to inertia. The only way to move them out of the way is to apply a force. If the person's body provides this force by pushing on the edge of a piece of glass, it can slice right through clothing, skin, and flesh. In the real world, jumping or driving through a plate glass window would be deadly.

PTS: 1 DIF: Bloom’s Level 6 REF: p. 93

NAT: B.4

234. ANS:

Units cancel in these ratios, but the units used must still be the same for both the initial and final values of the quantity.

PTS: 1 DIF: Bloom's Level 4 REF: p. 244

NAT: B.4

235. ANS:

Answers will vary. Momentum can be changed by increasing or decreasing mass, or by increasing, decreasing, or changing the direction of velocity. Note that breaking the marble in half or into many smaller pieces does not necessarily change momentum.

PTS: 1 DIF: Bloom's Level 5 REF: p. 230

NAT: B.4

236. ANS:

Answers will vary. Students may find ways of preventing the egg from gathering momentum (such as a parachute or a long ramp), or they may find ways of preventing the momentum from changing too quickly (such as an air bag).

PTS: 1 DIF: Bloom's Level 5 REF: p. 231

NAT: B.4

237. ANS:

The statement ignores the fact that the bat and the ball have different masses. The more massive bat can give a much greater speed to the less massive ball. Also, the bat and ball are not an isolated system. The batter and the ground also contribute to the momentum change of the ball.

PTS: 1 DIF: Bloom's Level 6 REF: p. 238

NAT: B.4

238. ANS:

Answers will vary. Two important points are these: First, the system of just the clay is not a closed, isolated system, because the clay is interacting with Earth. Second, the clay falls due to gravitational attraction from Earth. According to gravitational theory, Earth is also attracted by the clay. The initial momentum was zero, and the total momentum of clay and Earth remained zero throughout the event, since Earth, with its relatively huge mass, was attracted to the clay just as the clay, with its relatively small mass, was attracted to Earth. Only in the system of just the clay did the momentum change, and that is not an isolated system.

PTS: 1 DIF: Bloom's Level 6 REF: pp. 236-237

NAT: B.4

239. ANS:

Answers will vary. These may include heat produced by the machine, sound produced by the machine, and the work needed to get the parts of the machine moving or stopped.

PTS: 1 DIF: Bloom's Level 5 REF: p. 268

NAT: B.5 | B.6

240. ANS:

Answers will vary. Any muscle exertion requires the burning of the body’s fuel, resulting in the release of waste products, the loss of body energy reserves, and a feeling of being tired. Consider an analogy with a gasoline engine. An engine burns fuel to move over a distance, overcoming forces such as friction, air resistance, and the car’s brakes if they are applied. But that same car will still burn fuel in a tug-of-war with another car, even though no work is done.

PTS: 1 DIF: Bloom's Level 5 REF: pp. 257-258

NAT: B.5 | B.6

241. ANS:

Kinetic energy is proportional to the square of the velocity. Any negative sign disappears when a quantity is squared.

PTS: 1 DIF: Bloom's Level 2 REF: p. 258

NAT: B.5 | B.6

242. ANS:

Answers will vary. One example is a spinning wheel pushing against an object along its edge, such as a spinning bicycle tire propelling a bicycle forward.

PTS: 1 DIF: Bloom's Level 2 REF: p. 287

NAT: B.5 | B.6

243. ANS:

Not as stated. Energy is always conserved, but before the clay ball dropped it had gravitational potential energy. As the clay collided with and stuck to the ground, that gravitational potential energy was transformed into other forms of energy, including heat.

PTS: 1 DIF: Bloom's Level 4 REF: pp. 293-295, 298

NAT: B.5 | B.6

244. ANS:

Not necessarily. The speeds of the balls will be different between the start and finish. The non-linear ramps are longer than the straight ramp, but if they can more than make up for this with a greater average speed on the ramp, then the ball on the straight ramp can lose the race.

PTS: 1 DIF: Bloom's Level 4 REF: p. 293

NAT: B.5 | B.6

245. ANS:

You actually do get a little of that energy back with each step, but instead of converting it all to kinetic energy, you convert that gravitational potential energy into other forms in the inelastic collisions of your foot with each step. Some of those forms of energy are heat (friction with the steps), vibration (the push of the stair on your foot), and sound (the clip-clop of your shoes on the steps).

PTS: 1 DIF: Bloom's Level 4 REF: pp. 289, 293

NAT: B.5 | B.6

246. ANS:

One could use specific heat to identify a metal by using calorimetry to determine the specific heat of the metal and looking up the specific heat value in a data table. The metal should be heated to a known initial temperature, perhaps by immersing it in boiling water for approximately 5-10 minutes. It can then be placed into a known mass of water at a known initial temperature in a well-insulated container. The final temperature of the water should be determined after the system reaches thermal equilibrium. The change in thermal energy of the water will be equal to the thermal energy change of the metal; the sum of the two thermal energies will be zero, allowing one to calculate the specific heat value of the metal.

PTS: 1 DIF: Bloom's Level 5 REF: pp. 318-319

NAT: B.6

247. ANS:

Surface waves, like deep water waves, have characteristics of longitudinal waves. The motion of a particle in the wave is parallel to the motion of the wave. This can be seen by an object on the surface approaching then retreating from an observer at the wave source. Waves on the surface also have characteristics of transverse waves because the surface of the water undulates, or rises and falls. This can be seen as an object on the surface of the water bobs up and down. The overall motion of particles in surface waves is to trace a circular path.

PTS: 1 DIF: Bloom's Level 5 REF: p. 382

NAT: B.6

248. ANS:

Both types of interference result from the superposition of two (or more) waves. In constructive interference, the displacement of both waves is in the same direction, resulting in a total amplitude that is the sum of the two displacements. In destructive interference, the magnitudes of the waves’ amplitudes are equal but in opposite directions, and the resulting sum of amplitudes is zero.

PTS: 1 DIF: Bloom's Level 5 REF: p. 389

NAT: B.5

249. ANS:

Maria is not correct. The law of reflection applies to all surfaces that are struck by light. The reason that rough-surfaced objects produce diffuse reflections is that there are many different points at which light rays hit the surface. Each ray strikes the surface at a different angle of incidence, so the angles of reflection are also all different. This produces scattering of light rather than one smooth reflected beam of light.

PTS: 1 DIF: Bloom's Level 6 REF: pp. 458-459

NAT: B.6

250. ANS:

Move the object closer to the mirror in each case. If it is a plane mirror, the image will remain the same size. If it is a convex mirror, the image will get larger. If it is a concave mirror, the image will decrease in size.

PTS: 1 DIF: Bloom's Level 6 REF: p. 473

NAT: B.6