# Review Problems

1. A sandbag is dropped from a hot air balloon that is at a height of 45.0 m and is falling at 3.25 m/s. How long after it is dropped does the bag hit the ground? How fast is it going when it hits the ground?
2. A car traveling north on the Pennsylvania Turnpike passes the Lansdale exit going 65 mph (29.1 m/s) and continues at the same speed. At the same moment, a car enters the southbound lane from rest and accelerates at the rate of 2.35 $m/s^2$ and continues to accelerate until it passes the first car which is heading the other way. If the second car is originally 2.00 miles (3.22 km) north of the first, how long does it take for the two cars to pass each other?
3. A rock falls from the edge of a cliff and strikes the ground at the bottom 5.25 s later. How high is the cliff? How fast is the rock moving when it reaches the ground?
4. A car initially traveling at 7.0 m/s accelerates to a speed of 12.0 m/s in 2.0 s. What is the average acceleration of the car? How far does it travel while accelerating?
5. A "hot" car traveling at 65 mph (29.1 m/s) northbound on the Pennsylvania Turnpike is passed by a "not so hot" car traveling at 75 mph (33.5 m/s). The second car cannot go any faster and continues at the same speed. After a decision making process of 3.00 s, the driver of the first car accelerates (with his car) at 4.00 $m/s^2$ until he passes the second car. How fast is he going when he passes the second car? How far have the two cars gone from the original location and how long does it take to catch the now slower car?
6. A water balloon is thrown vertically downward from the edge of a building with a speed of 15.5 m/s. It is directed at the head of an unsuspecting physics teacher exactly 15.0 m below the point where the balloon is released. How fast is the balloon moving when it reaches the teacher? How long does it take to get there?
7. The bell towers of the Gesu church are approximately 24 m (8 stories) high. If a stone is dropped from the top of one of them and the effect of the air is negligible, how long will it take to reach the ground? How fast will it be moving (in m/s) when it reaches the ground?
8. A space vehicle moving at 48.5 m/s fires its engine in order to slow down. The magnitude of the acceleration produced by the engine is 3.65 $m/s^2$. If the rocket must slow to 12.0 m/s, how long must the engine be fired? How far does the spacecraft move during this time?
9. An unobservant speeder flies past a state trooper at 120.0 km/hr. The inexperienced trooper, forgetting that he has a radio whose waves travel at the speed of light, decides to pursue the offender himself and immediately begins to accelerate at a constant 3.55 $m/s^2$. How far have the two traveled by the time the trooper catches the speeder and how fast is the trooper moving at that time?
10. A car traveling at 55.8 km/hr accelerates uniformly to 97.2 km/hr and covers a distance of 0.250 km while doing so. What is the acceleration of the car in $m/s^2$ and how long (in seconds) does it take to change speed? ***Unit conversions are needed here!***
11. An automobile which set the world record for acceleration, increased its speed from rest to 96.0 km/hr in 3.07 s. What distance was traveled by the time it reached its final speed? What was its acceleration in $m/s^2$?

12. A car begins at rest and accelerates to 75.0 km/h in 25.0 s. It then continues at constant speed for 25.0 minutes. After the period of constant velocity, it stops over a distance of 125 m. What is the total distance covered by the trip? How long did the entire trip take?

13. An action figure is carried aloft by a helium filled balloon at a constant speed of 12.5 m/s until it reaches a height of 43.2 m at which time the balloon bursts and the tiny plastic person falls back to the ground. How long does the entire trip take and how fast is the action figure going when it hits the ground?

14. Two cars begin moving in opposite directions toward each other (but in different lanes.) One car accelerates toward the South at 3.45 $m/s^2$, the other accelerates toward the North at 2.25 $m/s^2$. If they begin at rest and at a distance of 1000 ±1 m apart, How far has each moved when they pass each other? How much time elapses until they pass each other? How fast is each going when they pass each other?

15. Two cars begin at rest and accelerate beginning at the same time. One car has an acceleration of 6.55 $m/s^2$ and the other has an acceleration of 6.65 $m/s^2$. After 15.0 s, how far is the faster car ahead of the slower car?

16. Stephanie serves a volleyball from a height of 0.80 m and gives it an initial velocity of +7.6 m/s straight up. (Not a very good serve.) How high will it go? How long will it take the ball to reach its maximum height?

17. A tennis ball is thrown vertically upward with an initial velocity of +8.0 m/s. What will its speed be when it returns to its starting point? b. How long will it take for it to reach its starting point?

18. A flowerpot falls from a windowsill 25.0 m above the sidewalk. How fast is the flowerpot moving when it strikes the ground? How much time does a passerby on the sidewalk below have to move out of the way before the flowerpot hits the ground?

19. A robot probe drops a camera off the rim of a 24-km-deep crater on Mars, where the free-fall acceleration is 3.7 $m/s^2$. Find the time required for the camera to reach the crater floor and the velocity with which it hits.

20. Maria throws an apple vertically upward from a height of 1.3 m with an initial velocity of +2.4 m/s. Will the apple reach Maria's friend in a tree house 5.3 m above the ground? If the apple is not caught, how long will the apple be in the air before it hits the ground?

21. A pebble is dropped from rest down a well and hits the water 1.5 s later. Using the equations for motion with constant acceleration, determine the distance from the edge of the well to the water's surface.

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22. What vector must be added to (20.5 m, 30.0°) in order to get a resultant vector of (46.7 m, 85.0°)? Express the vector in polar form.

23. A roller coaster moves 85 m horizontally, then travels 45 m at an angle of 30.0° above the horizontal. What is its displacement from its starting point?

24. Sketch the situation (free hand) and determine where the bug ends up relative to its starting point. A bug walks vertically upward on the blackboard a distance of 15.5 cm. It then walks horizontally to the left a distance of 10.7 cm. Finally, it walks in the direction +45.0° a distance of 45.0 cm. Express its location in polar form.

25. Sketch the situation (free hand) and calculate **A** + **B**. **A** = ( 24 , 120.0°); **B** = ( 18, 35.0°). Express the resultant in polar form.

# Review Problems

26. Convert the following vectors from one form to the other. Express the resultant in both component and polar forms. Use the standard Cartesian coordinate system.

| | magnitude | direction | x component | y component |
|---|---|---|---|---|
| **A** | | | 15.24 N | 15.75 N |
| **B** | 18.0 m | -90.0° | | |
| **C** | | | -13.2 m/s | 22.0 m/s |
| **D** | 7.35 N | 120.0° | | |
| **E** | | | 0 | 47.0 m |
| **A – D** | | | | |

| | | | | |
|---|---|---|---|---|
| | 12.5 lb | 60.0° | | |

27. Convert the following vectors from one form to the other. Express the resultant in both component and polar forms. Use the standard Cartesian coordinate system.

| | magnitude | direction | x component | y component |
|---|---|---|---|---|
| **A** | | | 15.20 m | 15.70 m |
| **B** | 25.0 N | 115º | | |
| **C** | 22.0 m/s | 62.3º | | |
| **D** | | | -8.00 m | -6.00 m |
| **E** | 46.8 m | Down | | |
| **A + D** | | | | |

28. Convert the following vectors from one form to the other and do the indicated calculation. Express the resultant in both component and polar forms. Use the standard Cartesian coordinate system.

| | magnitude | direction | x component | y component |
|---|---|---|---|---|
| **A** | 8.75 m | 40.5° | | |
| **B** | 12.25 m | -35.0° | | |
| **C** | 15.0 m/s$^2$ | Up | | |
| **D** | | | -8.00 m | -6.00 m |
| **E** | | | 0 | 47.0 m |
| **A – B** | | | | |

29. An escalator is 20.0 m long and takes 50.0 s to move a person from the bottom to the top and a person can walk along the escalator with a speed of 0.500 m/s relative to the escalator, How long will it take the person to walk up the up escalator? (This is a one-dimensional problem – no angles.)

30. An escalator is 20.0 m long and takes 50.0 s to move a person from the bottom to the top and a person can walk along the escalator with a speed of 0.500 m/s relative to the escalator, How long will it take the person to walk down the up escalator?

31. A plane can fly at 235 km/h through still air. If there is a wind out of the west at 55.0 km/h, in what direction must the plane head in order to move northeast relative to the earth? (Hint: The angle measure of Northeast is +45.0° and the sine and cosine of 45° are the same.

32. A plane can fly at 235 km/h through still air. If there is a wind out of the west at 55.0 km/h, in what direction must the plane head in order to move 25º North of West relative to the earth

33. A boat capable of moving at 3.5 m/s through still water is found to be moving in a direction 30.0° below directly across (60.0° from the river bank) when pointed directly across the river. What is the speed of the current?

34. An airplane heads northwest with an air speed of 235 km/h and encounters a wind out of the west at 45.0 km/h. What is the plane's velocity relative to the ground?

35. A river flows due east at 1.50 m/s. A boat crosses the river from the south shore to the north shore by maintaining a constant velocity of 11.0 m/s due north relative to the water. What is the velocity of the boat as viewed by a stationary observer on shore?

36. A river flows due east at 1.50 m/s. A boat crosses the river from the south shore to the north shore by maintaining a constant velocity of 11.0 m/s due north relative to the water. If the river is 305 m wide, how far downstream has the boat moved by the time it reaches the north shore?

37. A swimmer can swim in still water at a speed of 9.50 m/s. He intends to swim directly across a river that flows toward the west at 3.75 m/s. What direction must he head?

38. A boat is noticed to be crossing a river whose current flows at 2.25 m/s. The boat is moving directly across the river from one bank to the other but is headed 15.0° upstream from the direction it is moving. What is the speed of the boat relative to the water?

39. A novice pilot sets a plane's controls, thinking the plane will fly at 250 km/h to the north. If the wind blows at 75 km/h toward the southeast, what is the plane's resultant velocity relative to the ground?

40. A thief at the airport in an attempt to escape accidentally runs onto a moving sidewalk going the opposite direction. The thief can run at 10.0 m/s and the policeman can run at only 8.0 m/s. The moving sidewalk is moving at 2.4 m/s and the policeman runs along side it. If the policeman is 10.0 m from the moving sidewalk when the thief enters it, how long will it take the policeman to close the gap?

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41. A stone is thrown horizontally from the surface of a bridge and lands 4.00s later 10.0 m from a point directly below where it was released. How high is the bridge? What was its initial velocity?

| | x direction | y direction |
|---|---|---|
| $\mathbf{d}_0$ | | |
| $\mathbf{d}$ | | |
| $\mathbf{v}_0$ | | |

| | | |
|---|---|---|
| **v** | | |
| **a** | | |
| **t** | | |

42. A stone is thrown at 25.0 m/s at an angle of 30.0° from the horizontal and lands on the roof of a building 5.95 m high. How far did the stone travel horizontally while in flight? How long was the stone in flight?

43. A student throws a water balloon with a speed of 23.0 m/s at an angle of 30.0° above the horizontal. The balloon is thrown from the edge of a flat roof and begins its flight 10.0 m above the ground. How long is it in the air? How far from the base of the building does it land?

44. A student throws a water balloon with a speed of 23.0 m/s at an angle of 30.0° below the horizontal. The balloon is thrown from the edge of a flat roof and begins its flight 10.0 m above the ground. How long is it in the air? How far from the base of the building does it land?

45. A baseball is thrown from the ground and hits a flower pot at the edge of the roof of a building whose roof is exactly 4.00 m above the point where the ball was released. It is thrown with an initial velocity of 12.0 m/s at an angle of 70.0° from the horizontal. The ball hits the flower pot while rising. How long is it in flight before hitting the flower pot? How far does it travel horizontally before hitting the flower pot?

46. A soccer ball is kicked from the ground at an angle of 40.0° from the horizontal with an initial speed of 15.0 m/s. How far from the kicker will it land?

47. A soccer ball is kicked from the ground at an angle of 37.0° from the horizontal and lands 75.5 m away from the point where it was kicked. What was the initial speed of the ball?

48. An automobile rounds a curve on a highway at constant speed of 90.0 km/h. In the process, the car alters its direction from due west to 30.0° north of west. The radius of curvature of the road is 165 m. Determine the average acceleration of the car in rounding the curve. **Nota Bene: You must determine both the change in velocity and the time over which it changed.**

49. A package in an airplane moving horizontally at 155 m/s is dropped when the altitude is 485 m. How long does it take the package to fall to the ground? How far does the package move horizontally while it falls?

50. A boy throws a ball horizontally from the edge of a cliff. The ball hits the ground 2.50 s later. How high is the cliff? If the speed of the ball when thrown was 5.25 m/s, how far from the base of the cliff does the ball land?

51. A gun has a muzzle speed of 355 m/s and is fired at ground level and at an angle of 40.0° from the horizontal. Determine the horizontal and vertical components of the initial velocity. How long is the bullet in the air? How far does it move horizontally in this time?

52. A projectile is fired upward at an angle of 60.0° from the horizontal and a speed of 225 m/s. Determine the magnitude and direction of the object's position after 10.0 s of flight. Draw a diagram of the projectile's path.

53. A bullet is fired horizontally from a height of 78.4 m and hits the ground 2450 m away. With what speed did the bullet leave the gun?

54. A student stands at the edge of a cliff and throws a stone horizontally over the edge with a speed of 18.55 m/s. The cliff is 50.00 m above a flat horizontal beach. How long after being released does the stone strike the beach? What is the vertical component of the stone's velocity when it hits the beach?

55. In a local bar, a customer slides an empty beer mug on the horizontal bar for a refill. The bartender is momentarily distracted and does not see the mug, which slides off the end of the bar and strikes the floor 1.400 m from the base of the bar. If the height of the bar is 0.8600 m, with what speed does the mug leave the bar? What is the vertical component of the mug's velocity when it hits the floor?

56. A student sets up an experiment designed to measure the muzzle velocity of a BB gun. A target is placed on a wall 3.00 m from the muzzle of the gun. The gun is positioned so that it is aimed horizontally at the target. If the BB strikes the target 0.210 m below where it was aimed, with what speed did it leave the gun?

57. A football kicked at an angle of 50.0° from the horizontal, travels a horizontal distance of 20.0 m before hitting the ground. Find the initial speed of the football. How long is it in the air?

58. A rifle is aimed horizontally through its bore at the center of a large target 225 0 m away. The initial velocity of the bullet is 515.0 m/s. How far below the center does the bullet strike the target?

59. A ball is thrown from the edge of a 25.0 m cliff with an initial velocity of 25.0 m/s at an angle of 20.0° below the horizontal. How far from the base of the cliff will it strike the ground?

60. A football player punts a football so that it will have a "hang time" (time of flight) of 4.50 s and land 45.7 m (50 yards) If the ball leaves the player's foot 1.52 m (5 ft) above the ground, what is the initial velocity (magnitude and direction) of the ball?

61. A ball rolls off the edge of a horizontal table top 1.750 m high. It strikes the floor at a point 2.100 m from the bottom of the table. How long was the ball in the air? What was the speed of the ball when it left the table?

62. A dart is thrown horizontally toward the bull's eye on the dart board with an initial speed of 10.0 m/s. It hits at a point directly below the bull's eye 0.19 s later. How far below the aimed point did it strike the board? How far was the player's hand from the dart board when the dart was released?

63. A rifle is aimed horizontally at a target 33 m away. The bullet strikes the target 2.0 cm below where it was aimed. What is the muzzle velocity of the rifle?

64. A stone is thrown from the edge of a 15.5 m high cliff. The initial velocity of the stone is 45.4 m/s and it is thrown downward at an angle of 15.0° below the horizontal. How far from the base of the cliff does it land?

65. A dive bomber is diving at an angle of 37.0° below the horizontal at a speed of 280 m/s. It releases a bomb when it is at an altitude of 400 m. How far does the bomb move horizontally before it strikes the ground?

66. A cannon is fired with a muzzle velocity of 215.0 m/s at an angle of 40.00° from the horizontal. The cannon ball hits(coming down) a target on the top of a ridge 40.00 m above the level of the cannon. What is the horizontal distance of the target from the cannon?

67. A ball bearing rolls off a horizontal table top onto another table. The vertical distance between the two tables is 12.5 cm. The horizontal gap between the tables is 6.25 cm. How fast does the ball have to be moving when it leaves the first table in order to make the jump?

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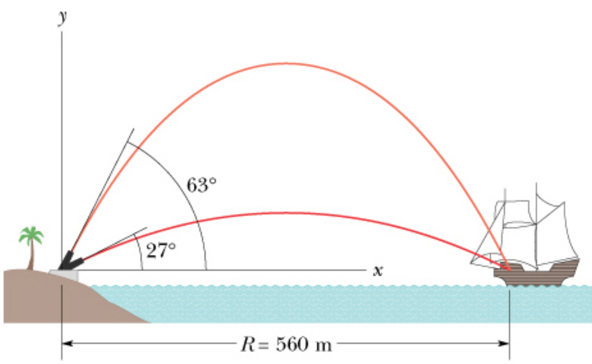
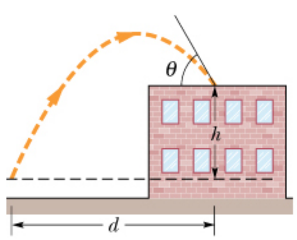
68. A player kicks a soccer ball from the ground toward the goal at an angle of 30.0º from horizontal. The goalie is 17.5 m from where the ball left the ground and catches it 2.25 m above the ground. What was the initial speed of the ball if it was rising when caught?

69. At what speed must the canon ball leave the canon so that it hits the ship after following the lower path?




speed: __________________________

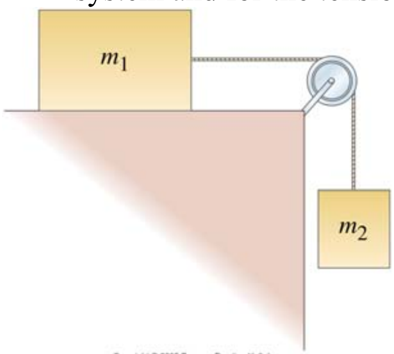
70. A stone is thrown at an angle of 65.0° from the horizontal with a speed of 22.4 m/s and lands some distance away on the roof of a building 7.00 m high. How far horizontally did the stone move from the point where it was thrown (*d*). If the wall of the building is 30.0 m from where the stone was thrown, how far from the edge of the building does the stone land?




*d*: __________________________

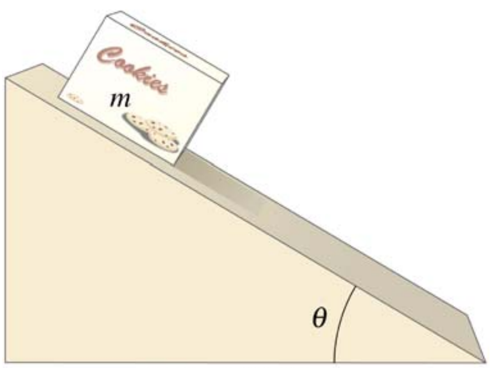
from edge: __________________________

71. The Figure shows a block (mass = $m_1$) on a smooth horizontal surface, connected by a thin cord that passes over a pulley to a second block (mass = $m_2$) which hangs vertically. (a) Draw a free-body diagram for each block, showing the force of gravity on each, the force (tension) exerted by the cord, and any normal force. (b) Apply Newton's second law to find formulas for the acceleration of the system and for the tension in the cord. Ignore friction and the masses of the pulley and cord.





72. The carton shown in the Figure lies on a plane tilted at an angle θ = 22.0º to the horizontal, with $\mu_k$ = 0.12. (a) Determine the acceleration of the carton as it slides down the plane. (b) If the carton starts from rest 9.30 m up the plane from its base, what will be the carton's speed when it reaches the bottom of the incline?





73. A block is given a push so that it slides up a ramp. After the block reaches its highest point, it slides back down but the magnitude of its acceleration is less on the descent than on the ascent. Why?

74. Whiplash sometimes results from an automobile accident when the victim's car is struck violently from the rear. Explain why the head of the victim seems to be thrown backward in this situation. Is it really?

75. What net force is needed to accelerate a child on a sled (total mass = 60.0 kg) at 1.25 m/s$^2$

76. A net force of 265 N accelerates a bike and rider at 2.30 m/s$^2$ What is the mass of the bike and rider together?

77. How much tension must a rope withstand if it is used to accelerate a 960 kg car horizontally along a frictionless surface at 1.2 m/s$^2$

78. What is the weight of a 76-kg astronaut (a) on Earth, (b) on the Moon (g = 1.7 m/s$^2$), (c) on Mars (g = 3.7 m/s$^2$)?

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79. A particular race car can cover a quarter-mile track (402 m) in 6.40 s starting from a standstill. Assuming the acceleration is constant, how many "g's" does the driver experience? If the combined mass of the driver and race car is 485 kg, what horizontal force must the road exert on the tires?

80. A 12.0-kg bucket is lowered vertically by a rope in which there is 163 N of tension at a given instant. What is the acceleration of the bucket? Is it up or down?

81. An elevator (mass 4850 kg) is to be designed so that the maximum acceleration is 0.0680g. What are the maximum and minimum forces the motor should exert on the supporting cable?

82. A 75 kg petty thief wants to escape from a third-story jail window. Unfortunately, a makeshift rope made of sheets tied together can support a mass of only 58 kg and when tied to a strong enough support, stops about two meters (the height of the thief) from the ground. How might the thief use this "rope" to escape? Give a quantitative answer.

83. One 3.2 kg paint bucket is hanging by a massless cord from another 3.2-kg paint bucket, also hanging by a massless cord, as shown in the Figure. (a) If the buckets are at rest, what is the tension in each cord? (b) If the two buckets are pulled upward with an acceleration of 1.60 m/s$^2$ by the cord, calculate the tension in each cord.



84. A 10.0 kg bucket is lowered by a rope (it is moving downward but the rope is exerting an upward force on it) in which there is 63.0 N of tension. What is the acceleration of the bucket? What is the direction (up or down) of the acceleration?

85. What is the apparent weight of a man whose mass is 85.5 kg when he is in an elevator that is accelerating downward at 2.75 m/s$^2$? What is the man's actual weight?

86. A 25.5 kg box is initially at rest on a plane inclined at 12.5°. The coefficient of static friction ($\mu_s$) between the box and the plane is 0.550 and $\mu_k$ = 0.400. What force exerted parallel to the plane is required to get it moving up the plane? What force is required to keep it moving up the plane at a constant speed?

87. A 15.0 kg object rests on a horizontal surface and the coefficient of static friction ($\mu_s$) for the surfaces is 0.650. The coefficient of kinetic friction ($\mu_k$) is 0.500. A 75.0 N force is applied on the object to the right. Draw a diagram with the four forces acting on the object. If the object is initially at rest, will it move? What is the maximum available frictional force? What is the actual frictional force?

88. What is the apparent weight of a man whose mass is 85.5 kg when he is in an elevator that is accelerating upward at 1.75 $m/s^2$? What is the man's actual weight?

89. A 10.0 kg object is suspended from two ropes from a horizontal ceiling. One rope make a 30.0° angle with the ceiling and the other makes a 60.0° angle with the ceiling. What is the tension in each rope?

90. Three forces are applied to an object. **A =** ( 35.55 N, 0.00000°); **B** = ( 75.00 N, 128.0°); **C** = ( 42.75 N, -53.00°). What single force must be applied to the object in order to balance the three forces mentioned here?

91. What net force is required to give a 25.5 kg mass an acceleration of 20.0 $m/s^2$?

92. A force of 4.500 N acts on a 2.540 kg mass. If this is the only force acting, what is the resulting acceleration?

93. A force of 3525 N acts Northward on a 1550 kg car. If another force of 2250 N acts on the same car toward the south, what acceleration will result?

94. A 1550 kg car experiences an upward force on the car of 14500 N exerted by a large electromagnet. What normal force does the ground exert on the car? What acceleration results? (Remember that the normal force can never be less than zero!)

95. A 1550 kg car experiences an upward force on the car of 16500 N exerted by a large electromagnet. What normal force does the ground exert on the car? What acceleration results? (Remember that the normal force can never be less than zero!)

96. What is the weight of 15.7 kg of lead? What is the weight of 15.7 kg of feathers? What is the mass of a quantity of gold that weighs 245 N?

97. A small rocket cart with a mass of 15.2 kg is on a horizontal track. The rocket engine delivers a thrust of 60.9 N and the cart encounters a total resistance (air and other forms of friction) of 4.50 N. What is the net force acting on the cart? What acceleration results from this force?

98. A 25.0 kg box sits on a horizontal floor with a helium filled balloon attached. If the buoyant force supplied by the balloon is 205 N, What normal force is supplied by the floor?

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99. It takes 345 N to keep a box that weighs 585 N sliding at a constant speed across a floor. What is the coefficient of kinetic friction ($\mu_k$)?

100. For steel against steel $\mu_s = 0.75$. What horizontal force is required to start a steel box sliding across a steel floor if its weight is 7500 N?

101. A brick has a mass of 1.20 kg. A force of 5.45 N is needed to move the brick along a horizontal surface with a constant velocity. What is the coefficient of friction?

102. For wood against wood $\mu_s = 0.550$. What is the force of friction acting on a wood block of mass 3.50 kg being pulled along a wood floor by a horizontal force?

103. A stone of mass 45.0 kg is pushed on a horizontal surface with $\mu_k = 0.855$. What force must be applied in order to produce an acceleration of 0.200 $m/s^2$?

104. A horizontal force of 30.0 N is required to slide a 12.0 kg crate across the floor at a constant velocity, what is $\mu_k$?

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105. Two people combine their efforts to exert 565 N of force on a stalled car to move it a distance of 65.0 m. How much work do they do?

106. How much work is done by a person weighing 545 N in climbing 5.00 m up a rope in a gym? What is the mass of the person?

107. A 60.0 kg man lifts himself on a chinning bar a distance of 0.35 m. What does the man weigh? What force must he exert to lift himself? How much work does he do? How much work does gravity do on the man?

108. A student pulls a cart on a level ( horizontal ) floor by means of a rope making an angle of 45.0° with the floor. The force exerted is 64.5 N and the cart moves 15.0 m. What is the magnitude of the component of the force that is doing work? How much work is done?

109. A person pushes a lawnmower 45.5 m across a level lawn with a force of 125 N along the handle which makes an angle of 35.0° with the ground. What is the magnitude of the component of the force that is doing work? How much work is done?

110. A piano weighing 2250 N is pushed up an inclined plane 3.25 m long into a truck whose platform is 1.25 m above the ground. Ignoring frictional losses, what force must be exerted to push the piano up the plane? What is the ideal mechanical advantage?

111. Using a set of pulleys, a mover raises a 525 kg crate a vertical distance of 5.00 m. This is accomplished by pulling in 20.0 m of rope. If this were an ideal machine, how much effort would be required to lift the crate? If the effort actually applied is 1525 N, what force is used to overcome friction? What is the work output? What is the work input?

112. If an ideal machine is used to move a 525 N resistance a distance of 25.0 m with an effort of 125 N, over what distance must the effort act?

113. Applying a force of 80.0 N over a distance of 7.50 m, a person uses a machine to lift a 425 N object a vertical distance of 1.45 m. Find the work input, the work output and the efficiency.

114. A machine has an ideal mechanical advantage of 3.00. If the efficiency is 0.750%, what is the real mechanical advantage?

115. In a set of pulleys, 8 cords hold up a resistance of 595 N. What is the ideal effort? How much cord must be pulled off the pulleys in order to raise the resistance 3.00 m?

116. A certain machine does 5750 j of useful work while losing 2550 j of energy to friction. Find the work input and the efficiency of the machine.

117. A 5.00 Kg object moving at 2.45 m/s slides across a frictionless, horizontal surface and strikes a spring with a spring constant of 145 N/m. How far is the spring compressed in stopping the object?

118. A 283 N box is raised 4.00 m by a machine that is 45.5% efficient. What is the work input? What is the work output? How much energy is lost to friction?

119. A box (mass of 12.8 kg) is thrown across a room and after hitting the ground, slides 2.50 m. If the box had a speed of 1.75 m/s immediately after it hit the ground, what is the coefficient of kinetic friction between the floor and the box? Use the Work/Energy theorem to solve this problem.

120. A 40.0 kg crate is pulled 5.00 m across a rough floor by a force of 227 N directed at an angle of 30.0º above the floor. The box is originally at rest and is moving at 5.00 m/s after the force acts on it. How much work is done by the applied force? What is the final kinetic energy of the crate? How much work is done by friction?

121. What is the kinetic energy of a 5.25 kg object moving at 1.25 m/s? If a 6.00 N force was used to accelerate this object from rest, how far did the object move while the force was applied?

122. A 4.55 kg crate slides along the floor and its speed decreases from 4.00 m/s to 1.25 m/s over a distance of 3.00 m. How much kinetic energy did it lose? What was the force of friction acting on the crate?

123. A 2.00 kg rock falls from the edge of a cliff that is 25.0 m above the ground below. What is the gravitational potential energy of the rock when it is at the top of the cliff? What is its kinetic energy after it has fallen half way to the ground? How fast is it moving at the half-way point?

124. A force of 5.00 N is applied to a 1.00 kg object over a distance of 3.00 m. What work is done by the force? If it was initially at rest, how fast is the object moving at the end of the 3.00 m? If the object were 2.00 kg, how much work would be done by the force?

125. A force of 5.00 N is applied to a 1.00 kg object over a distance of 3.00 m. What work is done by the force? If it was initially at rest, how fast is the object moving at the end of the 3.00 m? If the object were 2.00 kg, how fast would it be moving at the end of the 3.00 m?

126. A 15500 kg truck accelerates without turning from 25.0 m/s to 34.0 m/s over a distance of 125 m. What is the kinetic energy increase of the truck? What was the average force exerted on the truck's tires by the road?

127. What is the spring constant of a spring that absorbs 457 j of energy while being compressed 0.250 m?

128. A spring with a constant of 625 N/m stops a 1.45 kg object moving horizontally at 3.25 m/s across a smooth (frictionless) surface. How much is the spring compressed in the process?

129. The coefficient of static friction ($\mu_s$) between the tires of a truck and the road is 0.800 and the coefficient of kinetic friction ($\mu_k$) between the tires of the same truck and the road is 0.700. How much work must be done by friction in stopping the truck? What is the minimum stopping distance for the truck if it is traveling at 65.0 mph (29.1 m/s) and it does not skid. What is the stopping distance if the wheels lock and the car skids?

130. A 5.25 kg object slides along a rough, horizontal surface ($\mu_k = 0.155$) and strikes a spring whose constant is 145 N/m with a speed of 2.45 m/s. How much is the spring compressed while stopping the object?

131. A 5.25 kg object slides with an initial speed of 4.45 m/s along a rough, horizontal surface ($\mu_k = 0.155$) and strikes a spring whose constant is 145 N/m after sliding a distance of 0.500 m. How fast is the object moving when it strikes the spring? How much is the spring compressed while stopping the object?

132. A 3.75 kg object slides down a plane inclined at 32.5º. It begins at rest and contacts a spring (k = 2450 N/m) after sliding 1.25 m. If $\mu_s = 0.425$, $\mu_k = 0.300$ and the surface of the plane is the same even where the spring acts, how far is the spring compressed while stopping the object?

133. A 5.00 kg object is dropped from a height of 7.50 m onto the top of a spring whose spring constant is 345 N/m. How much is the spring compressed while stopping the object?

# Review Problems

134. What is the power of a motor that can do 395 j of work in 12.5 s? How much work can it do in 5.00 m?
135. How many joules of work can a 1.00 hp motor do in 1.00 m?
136. How long will it take a 525 w machine to raise a 475 kg object 12.5 m?
137. A certain horse can pull 25 buckets full of water out of a 3.25 m deep well in one hour. If the average mass of the water in a bucket is 5.00 kg, what is the power of the horse in watts and horsepower?
138. A boy applies a steady force of 32 N to a cart and pushes it 12 m in 16 s. How much work does he do? What is his power output during the process?
139. A motor raises a 5500 N elevator 7.5 m in 15 seconds. Find the work done and the power generated by the motor.
140. A 60.0 kg person runs up 3 flights of steps to a floor 11.0 m above the starting point. If the run takes 24.0 s, what is the power of the person? How much work is done?
141. A motor capable of delivering 350 w of power operates a 6.00 kg electric train in which 150 N of friction must be overcome. What is the maximum speed that the motor can keep the train running?

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142. A speedboat has a mass of 525 kg. It starts at rest and reaches a speed of 40.5 m/s in 3.00 s. What is the change in momentum of the boat? What magnitude force (average) produced the acceleration?
143. A 1750 kg car changes its speed from 10.0 m/s to 30.0 m/s during a 10.0 s interval. What is the car's change in momentum? What average magnitude force produced the acceleration?
144. A bullet whose mass is .050 kg leaves the muzzle of a gun with a speed of 425 m/s. If the mass of the gun and its support is 12.0 kg, with what speed does the gun recoil from the explosion?
145. A steel pellet ( m = 0.025 kg) with a speed of 105 m/s strikes and is embedded in a 0.250 kg stationary piece of wood on a frictionless surface. With what velocity do the two things leave the impact location?
146. A cart ( m = 0.500 kg) moving at 3.00 m/s collides head on with another cart ( m = 1.000 kg ) and sticks to it. If the second cart was moving toward the first with a speed of 1.500 m/s, what is the velocity of the combined object after the collision?
147. A 4.55 kg lump of clay initially moving at 1.25 m/s collides with another lump of clay (m = 2.40 kg) which is initially at rest on a frictionless surface. The two lumps stick together. With what velocity do the two move after the collision? How much kinetic energy is lost in the collision?
148. An explosion in a rifle lasts for about 1.45 ms and causes a 25.0 g bullet to leave the gun moving at 345 m/s. What average force does the explosion apply on the bullet? Assume that friction and other forces are negligible.

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149. A ball of mass 0.440 kg moving east ( $+x$ direction) with a speed of 3.30 m/s collides head-on with a 0.220 kg ball at rest. If the collision is perfectly elastic, what will be the speed and direction of each ball after the collision?

150. A 0.450-kg ice puck, moving east with a speed of 3.00 m/s has a head-on collision with a 0.900-kg puck initially at rest. Assuming a perfectly elastic collision, what will be the speed and direction of each object after the collision?

151. Two billiard balls of equal mass undergo a perfectly elastic head-on collision. If one ball's initial speed was 2.00 m/s and the other's was 3.00 m/s in the opposite direction, what will be their speeds after the collision?

152. A 0.060-kg tennis ball, moving with a speed of 2.50 m/s collides head-on with a 0.090-kg ball initially moving away from it at a speed of 1.15 m/s. Assuming a perfectly elastic collision, what are the speed and direction of each ball after the collision?

153. A softball of mass 0.220 kg that is moving with a speed of 8.5 m/s collides head-on and elastically with another ball initially at rest. Afterward the incoming softball bounces backward with a speed of 3.7 m/s Calculate (*a*) the velocity of the target ball after the collision, and (*b*) the mass of the target ball.

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154. What is the acceleration due to gravity on the surface of Neptune?

155. What is the force of gravitational attraction between Jupiter and the sun?

156. What is the Kepler's Third Law constant for the planet Venus?

157. An earth satellite moves in a circular orbit with a radius of $7.01 \times 10^6$ m. The time for one revolution is 98.0 minutes. What is the speed of the satellite in m/s? What is the centripetal acceleration?

158. A stone attached to a string 2.00 m long is whirled in a horizontal circle. At what speed must the stone move for its centripetal acceleration to be equal to the acceleration of gravity?

159. An airplane flying at constant speed in a horizontal circular path of radius of 5525 m is observed to complete each round trip in 435 s. What is the speed of the airplane? What is the centripetal acceleration?

160. A fan blade has a 0.200 m radius. If it makes 20.0 revolutions per second, What is the period of revolution of the blade? What is the centripetal acceleration of a point on the tip of the blade?