Instructor(s): *Field/Furic*

PHYSICS DEPARTMENT

PHY 2053   Exam 1   October 3, 2012

Name (print, last first): _____   Signature: _____

On my honor, I have neither given nor received unauthorized aid on this examination.

YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

(1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number).** Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY**. Code your UFID number on your answer sheet.
(2) Print your name on this sheet and sign it also.
(3) Do all scratch work anywhere on this exam that you like. **Circle your answers on the test form.** At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.
(4) **Blacken the circle of your intended answer completely, using a #2 pencil or <u>blue</u> or <u>black</u> ink**. Do not make any stray marks or some answers may be counted as incorrect.
(5) **The answers are rounded off. Choose the closest to exact. There is no penalty for guessing. If you believe that no listed answer is correct, leave the form blank.**
(6) Hand in the answer sheet separately.

Use $g = 9.80 \text{ m/s}^2$

1. The mass of an object:

   (1) is a property of an object that specifies how difficult it is the change the velocity of the object.
   (2) is zero if there is no gravity present.
   (3) is larger for bigger objects.
   (4) increases with the speed of the object.
   (5) increases with the force on the object.

2. If vector $\vec{A} = 3\hat{x} - 5\hat{y}$ and vector $\vec{B} = 2\hat{x} + 3\hat{y}$, what is the magnitude of the vector $\vec{A} - \vec{B}$ divided by the magnitude of the vector $\vec{A} + \vec{B}$? Namely, what is $\dfrac{|\vec{A} - \vec{B}|}{|\vec{A} + \vec{B}|}$?

   (1) 1.50   (2) 2.24   (3) 0.26   (4) 0.19   (5) 5.39

3. If vector $\vec{A} = 1\hat{x} + 5\hat{y}$ and vector $\vec{B} = 2\hat{x} - 3\hat{y}$, what is the magnitude of the vector $\vec{A} - \vec{B}$ divided by the magnitude of the vector $\vec{A} + \vec{B}$? Namely, what is $\dfrac{|\vec{A} - \vec{B}|}{|\vec{A} + \vec{B}|}$?

   (1) 2.24   (2) 1.50   (3) 0.26   (4) 0.19   (5) 5.39

4. If vector $\vec{A} = 1\hat{x} - 5\hat{y}$ and vector $\vec{B} = 2\hat{x} - 3\hat{y}$, what is the magnitude of the vector $\vec{A} - \vec{B}$ divided by the magnitude of the vector $\vec{A} + \vec{B}$? Namely, what is $\dfrac{|\vec{A} - \vec{B}|}{|\vec{A} + \vec{B}|}$?

   (1) 0.26   (2) 1.50   (3) 2.24   (4) 0.19   (5) 5.39

5. An object is released from rest at $t = 0$ near the surface of the Earth. How far does it fall during the time interval from $t = 1$ s to $t = 3$ s? Ignore air resistance.

   (1) 39.2 m   (2) 58.8 m   (3) 78.4 m   (4) 19.6 m   (5) 24.5 m

6. An object is released from rest at $t = 0$ near the surface of the Earth. How far does it fall during the time interval from $t = 2$ s to $t = 4$ s? Ignore air resistance.

   (1) 58.8 m   (2) 39.2 m   (3) 78.4 m   (4) 19.6 m   (5) 24.5 m

7. An object is released from rest at $t = 0$ near the surface of the Earth. How far does it fall during the time interval from $t = 3$ s to $t = 5$ s? Ignore air resistance.
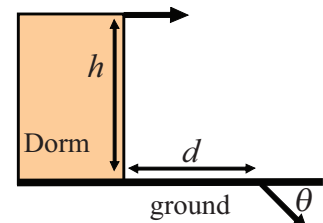
(1) 78.4 m   (2) 39.2 m   (3) 58.8 m   (4) 19.6 m   (5) 24.5 m

8. A beanbag is thrown horizontally from a dorm room window a height of $h = 10$ meters above the ground as shown in the figure. If the beanbag's velocity just before impact with the ground is $\theta = 30°$ below the horizontal, at what horizontal distance d (in m) from the dorm directly below the window from which it was thrown does the beanbag hit the ground? Ignore air resistance.
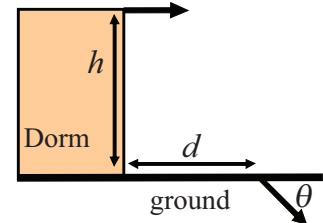
(1) 34.6   (2) 23.8   (3) 16.8   (4) 42.8   (5) 10.5

9. A beanbag is thrown horizontally from a dorm room window a height of $h = 10$ meters above the ground as shown in the figure. If the beanbag's velocity just before impact with the ground is $\theta = 40°$ below the horizontal, at what horizontal distance d (in m) from the dorm directly below the window from which it was thrown does the beanbag hit the ground? Ignore air resistance.

(1) 23.8   (2) 34.6   (3) 16.8   (4) 42.8   (5) 10.5

10. A beanbag is thrown horizontally from a dorm room window a height of $h = 10$ meters above the ground as shown in the figure. If the beanbag's velocity just before impact with the ground is $\theta = 50°$ below the horizontal, at what horizontal distance d (in m) from the dorm directly below the window from which it was thrown does the beanbag hit the ground? Ignore air resistance.
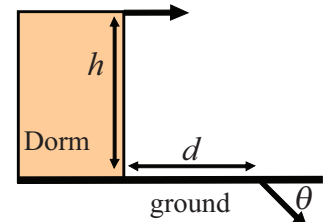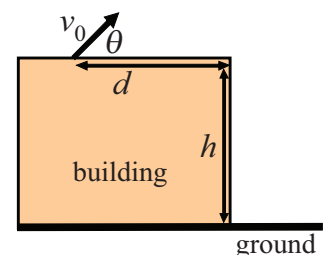
(1) 16.8   (2) 34.6   (3) 23.8   (4) 42.8   (5) 10.5

11. Near the surface of the Earth a projectile is fired from the top of a building at a height h above the ground at an angle θ relative to the horizontal and at a distance d from the edge of the building as shown in the figure. If $\theta = 20°$ and $d = 20$ m, what is the minimum initial speed, v_0, of the projectile such that it will make it off the building and reach the ground? Ignore air resistance.
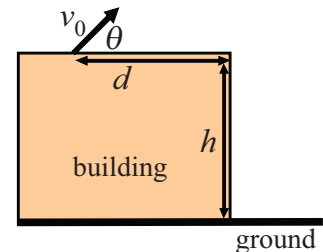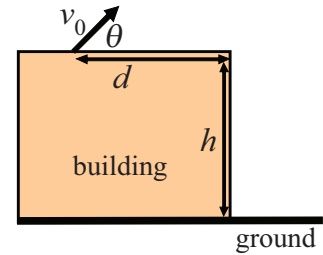
(1) 17.5 m/s   (2) 15.0 m/s   (3) 14.1 m/s   (4) 9.8 m/s   (5) 22.5 m/s

12. Near the surface of the Earth a projectile is fired from the top of a building at a height h above the ground at an angle θ relative to the horizontal and at a distance d from the edge of the building as shown in the figure. If $\theta = 30°$ and $d = 20$ m, what is the minimum initial speed, v_0, of the projectile such that it will make it off the building and reach the ground? Ignore air resistance.

(1) 15.0 m/s   (2) 17.5 m/s   (3) 14.1 m/s   (4) 9.8 m/s   (5) 22.5 m/s

13. Near the surface of the Earth a projectile is fired from the top of a building at a height h above the ground at an angle θ relative to the horizontal and at a distance d from the edge of the building as shown in the figure. If $\theta = 40°$ and $d = 20$ m, what is the minimum initial speed, v_0, of the projectile such that it will make it off the building and reach the ground? Ignore air resistance.
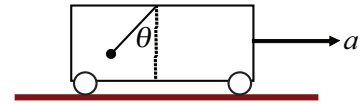

(1) 14.1 m/s　　　(2) 17.5 m/s　　　(3) 15.0 m/s　　　(4) 9.8 m/s　　　(5) 22.5 m/s

14. Consider a mass $M = 2$ kg suspended by a very light string from the ceiling of a railway car near the surface of the Earth. The car has a constant acceleration as shown in the figure, causing the mass to hang at an angle θ with the vertical. If the tension in the string is 20 N, what is the acceleration (in m/s^2) of the railway car?
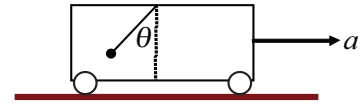

(1) 2.0　　　(2) 11.4　　　(3) 17.4　　　(4) 1.6　　　(5) 12.2

15. Consider a mass $M = 2$ kg suspended by a very light string from the ceiling of a railway car near the surface of the Earth. The car has a constant acceleration as shown in the figure, causing the mass to hang at an angle θ with the vertical. If the tension in the string is 30 N, what is the acceleration (in m/s^2) of the railway car?


(1) 11.4　　　(2) 2.0　　　(3) 17.4　　　(4) 1.6　　　(5) 12.2

16. Consider a mass $M = 2$ kg suspended by a very light string from the ceiling of a railway car near the surface of the Earth. The car has a constant acceleration as shown in the figure, causing the mass to hang at an angle θ with the vertical. If the tension in the string is 40 N, what is the acceleration (in m/s^2) of the railway car?
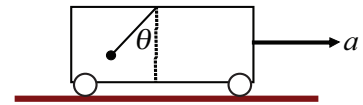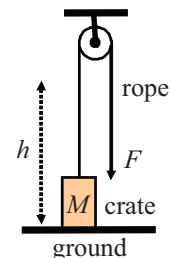

(1) 17.4　　　(2) 2.0　　　(3) 11.4　　　(4) 1.6　　　(5) 12.2

17. A student is using a simple pulley to lift a crate of mass $M = 30$ kg from rest to a height h by pulling on the rope with a force F as shown in the figure. If the breaking strength of the rope is 400 N, what is the minimum time (in s) required for the student to haul the crate to a height $h = 20$ m? (Assume that the pulley is massless and frictionless.)
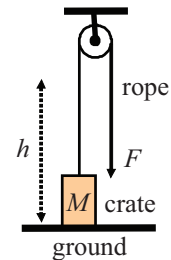
(1) 3.4
(2) 5.0
(3) 14.1
(4) 2.5
(5) 16.2

18. A student is using a simple pulley to lift a crate of mass $M = 35$ kg from rest to a height h by pulling on the rope with a force F as shown in the figure. If the breaking strength of the rope is 400 N, what is the minimum time (in s) required for the student to haul the crate to a height $h = 20$ m? (Assume that the pulley is massless and frictionless.)
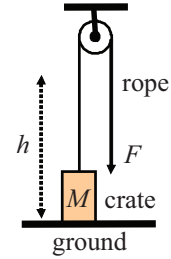

(1) 5.0
(2) 3.4
(3) 14.1
(4) 2.5
(5) 16.2

19. A student is using a simple pulley to lift a crate of mass $M = 40$ kg from rest to a height h by pulling on the rope with a force F as shown in the figure. If the breaking strength of the rope is 400 N, what is the minimum time (in s) required for the student to haul the crate to a height $h = 20$ m? (Assume that the pulley is massless and frictionless.)

(1) 14.1
(2) 3.4
(3) 5.0
(4) 2.5
(5) 16.2

20. At what height above the Earth's surface would your weight be 1/4 of what it is at the surface of the Earth? (Note: R_E is the radius of the Earth.)

(1) R_E (2) $2R_E$ (3) $3R_E$ (4) $4R_E$ (5) $R_E/2$

21. At what height above the Earth's surface would your weight be 1/9 of what it is at the surface of the Earth? (Note: R_E is the radius of the Earth.)

(1) $2R_E$ (2) R_E (3) $3R_E$ (4) $4R_E$ (5) $R_E/2$

22. At what height above the Earth's surface would your weight be 1/16 of what it is at the surface of the Earth? (Note: R_E is the radius of the Earth.)

(1) $3R_E$ (2) R_E (3) $2R_E$ (4) $4R_E$ (5) $R_E/2$

23. When on the ground, Ian's weight is measured to be 650 N. When Ian is on an elevator near the surface of the Earth, his apparent weight is 700 N. What is the net force on the system (Ian and the elevator) if their combined mass is 1050 kg?
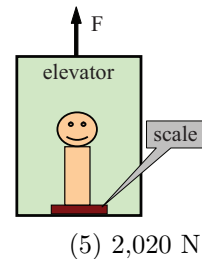
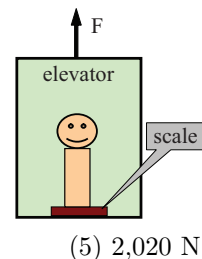(1) 791.5 N   (2) 949.8 N   (3) 1,108 N   (4) 650.7 N   (5) 2,020 N

24. When on the ground, Ian's weight is measured to be 650 N. When Ian is on an elevator near the surface of the Earth, his apparent weight is 710 N. What is the net force on the system (Ian and the elevator) if their combined mass is 1050 kg?

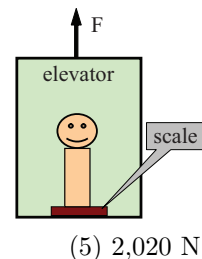(1) 949.8 N   (2) 791.5 N   (3) 1,108 N   (4) 650.7 N   (5) 2,020 N

25. When on the ground, Ian's weight is measured to be 650 N. When Ian is on an elevator near the surface of the Earth, his apparent weight is 720 N. What is the net force on the system (Ian and the elevator) if their combined mass is 1050 kg?
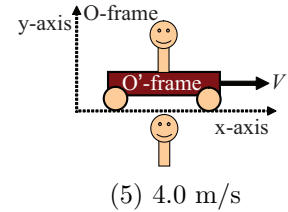
(1) 1,108 N   (2) 791.5 N   (3) 949.8 N   (4) 650.7 N   (5) 2,020 N

26. A train (O'-frame) is moving down the x-axis of the O-frame at speed $V = 5$ m/s. An observer at rest in the O'-frame throws a stone straight up with speed $v'_y = 4$ m/s (as observed in the O'-frame). What is the speed of the stone as measured by an observer at rest in the O-frame?

(1) 6.4 m/s   (2) 7.8 m/s   (3) 8.5 m/s   (4) 5.0 m/s   (5) 4.0 m/s

27. A train (O'-frame) is moving down the x-axis of the O-frame at speed $V = 6$ m/s. An observer at rest in the O'-frame throws a stone straight up with speed $v'_y = 5$ m/s (as observed in the O'-frame). What is the speed of the stone as measured by an observer at rest in the O-frame?

(1) 7.8 m/s   (2) 6.4 m/s   (3) 8.5 m/s   (4) 5.0 m/s   (5) 4.0 m/s

28. A train (O'-frame) is moving down the x-axis of the O-frame at speed $V = 6$ m/s. An observer at rest in the O'-frame throws a stone straight up with speed $v'_y = 6$ m/s (as observed in the O'-frame). What is the speed of the stone as measured by an observer at rest in the O-frame?
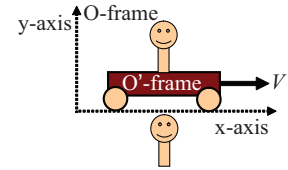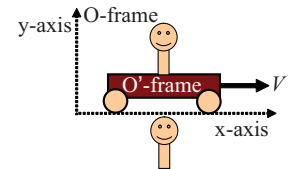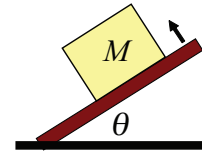
(1) 8.5 m/s   (2) 6.4 m/s   (3) 7.8 m/s   (4) 5.0 m/s   (5) 4.0 m/s

29. Near the surface of the Earth, a block of mass M is at rest on a plane inclined at angle θ to the horizontal. As the angle θ is increased, the block begins to slip when $\theta = 35°$. What is the coefficient of static friction between the block and the surface of the plane?

(1) 0.70   (2) 0.58   (3) 0.47   (4) 0.36   (5) 0.84

30. Near the surface of the Earth, a block of mass M is at rest on a plane inclined at angle θ to the horizontal. As the angle θ is increased, the block begins to slip when $\theta = 30°$. What is the coefficient of static friction between the block and the surface of the plane?

(1) 0.58   (2) 0.70   (3) 0.47   (4) 0.36   (5) 0.84

31. Near the surface of the Earth, a block of mass M is at rest on a plane inclined at angle θ to the horizontal. As the angle θ is increased, the block begins to slip when $\theta = 25°$. What is the coefficient of static friction between the block and the surface of the plane?
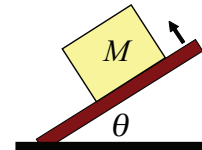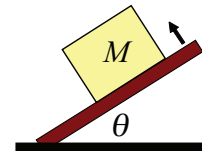
(1) 0.47   (2) 0.70   (3) 0.58   (4) 0.36   (5) 0.84

32. A block of mass $M_2 = 1$ kg on a horizontal surface is connected by a cord over a massless, frictionless pulley to a second block of mass $M_1 = 2$ kg. If the static and kinetic coefficient of friction between the table and mass M_2 are $\mu_s = 0.5$ and $\mu_k = 0.2$, respectively, what is the magnitude of the acceleration of block M_1 after the blocks are released from rest?

(1) $3g/5$ (2) $7g/10$ (3) zero   (4) $2g/3$ (5) $3g/4$
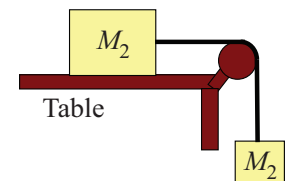
33. A block of mass $M_2 = 1$ kg on a horizontal surface is connected by a cord over a massless, frictionless pulley to a second block of mass $M_1 = 3$ kg. If the static and kinetic coefficient of friction between the table and mass M_2 are $\mu_s = 0.5$ and $\mu_k = 0.2$, respectively, what is the magnitude of the acceleration of block M_1 after the blocks are released from rest?

(1) $7g/10$ (2) $3g/5$ (3) zero   (4) $2g/3$ (5) $3g/4$
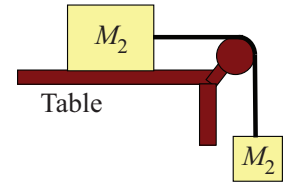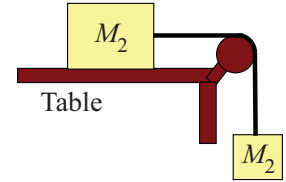
34. A block of mass $M_2 = 2$ kg on a horizontal surface is connected by a cord over a massless, frictionless pulley to a second block of mass $M_1 = 1$ kg. If the static and kinetic coefficient of friction between the table and mass M_2 are $\mu_s = 0.5$ and $\mu_k = 0.2$, respectively, what is the magnitude of the acceleration of block M_1 after the blocks are released from rest?

(1) zero   (2) $3g/5$ (3) $7g/10$ (4) $2g/3$ (5) $3g/4$

35. A potter's wheel rotates from rest to 240 rpm in a time of 2 seconds. Assuming constant angular acceleration, how many revolutions does the wheel make during this time interval?

(1) 4   (2) 6   (3) 8   (4) 2   (5) 10

36. A potter's wheel rotates from rest to 360 rpm in a time of 2 seconds. Assuming constant angular acceleration, how many revolutions does the wheel make during this time interval?

(1) 6   (2) 4   (3) 8   (4) 2   (5) 10

37. A potter's wheel rotates from rest to 480 rpm in a time of 2 seconds. Assuming constant angular acceleration, how many revolutions does the wheel make during this time interval?

(1) 8   (2) 4   (3) 6   (4) 2   (5) 10

38. Two point masses are located on the x-axis. Mass m_1 is at the origin (*i.e.*, $x = 0$) and mass m_2 is at $x = d$. If $m_2 = 2m_1$, at what point on the x-axis is the *net* gravitational force on a test mass m from the two masses equal to zero?

(1) $x = 0.41d$ (2) $x = 0.37d$ (3) $x = 0.33d$ (4) $x = 0.59d$ (5) $x = -2.41d$

39. Two point masses are located on the x-axis. Mass m_1 is at the origin (*i.e.*, $x = 0$) and mass m_2 is at $x = d$. If $m_2 = 3m_1$, at what point on the x-axis is the *net* gravitational force on a test mass m from the two masses equal to zero?

(1) $x = 0.37d$ (2) $x = 0.41d$ (3) $x = 0.33d$ (4) $x = 0.59d$ (5) $x = -2.41d$

40. Two point masses are located on the x-axis. Mass m_1 is at the origin (*i.e.*, $x = 0$) and mass m_2 is at $x = d$. If $m_2 = 4m_1$, at what point on the x-axis is the *net* gravitational force on a test mass m from the two masses equal to zero?
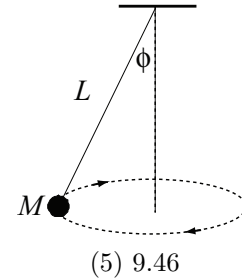
(1) $x = 0.33d$ (2) $x = 0.41d$ (3) $x = 0.37d$ (4) $x = 0.59d$ (5) $x = -2.41d$

41. Near the surface of the earth, a conical pendulum is constructed from a stone of mass M connected to a cord with length L and negligible mass. The stone is undergoing uniform circular motion in the horizontal plane as shown in the figure. If the cord makes an angle $\phi = 40°$ with the vertical direction and the period of the circular motion is 3 s, what is the length L of the cord (in meters)?
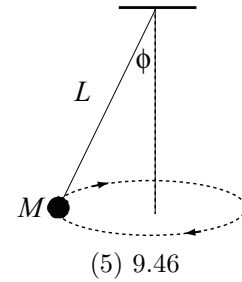
(1) 2.92   (2) 5.18   (3) 8.10   (4) 1.85   (5) 9.46

42. Near the surface of the earth, a conical pendulum is constructed from a stone of mass M connected to a cord with length L and negligible mass. The stone is undergoing uniform circular motion in the horizontal plane as shown in the figure. If the cord makes an angle $\phi = 40°$ with the vertical direction and the period of the circular motion is 4 s, what is the length L of the cord (in meters)?

(1) 5.18   (2) 2.92   (3) 8.10   (4) 1.85   (5) 9.46

43. Near the surface of the earth, a conical pendulum is constructed from a stone of mass M connected to a cord with length L and negligible mass. The stone is undergoing uniform circular motion in the horizontal plane as shown in the figure. If the cord makes an angle $\phi = 40°$ with the vertical direction and the period of the circular motion is 5 s, what is the length L of the cord (in meters)?
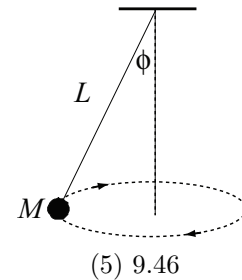
(1) 8.10   (2) 2.92   (3) 5.18   (4) 1.85   (5) 9.46

44. An elevator cable winds on a drum of radius 75.0 cm that is connected to a motor. If the elevator is moving down at 0.50 m/s, what is the angular speed of the drum?

(1) 0.67 rad/s   (2) 0.80 rad/s   (3) 0.93 rad/s   (4) 0.50 rad/s   (5) 0.75 rad/s

45. An elevator cable winds on a drum of radius 75.0 cm that is connected to a motor. If the elevator is moving down at 0.60 m/s, what is the angular speed of the drum?

(1) 0.80 rad/s   (2) 0.67 rad/s   (3) 0.93 rad/s   (4) 0.50 rad/s   (5) 0.75 rad/s

46. An elevator cable winds on a drum of radius 75.0 cm that is connected to a motor. If the elevator is moving down at 0.70 m/s, what is the angular speed of the drum?

(1) 0.93 rad/s   (2) 0.67 rad/s   (3) 0.80 rad/s   (4) 0.50 rad/s   (5) 0.75 rad/s

47. A highway curve has a radius of 125 m. At what angle should the road be banked so that a car traveling at 20 m/s has no tendency to skid sideways on the road? (Hint: No tendency to skid means the frictional force is zero.)

(1) 18.1°   (2) 36.3°   (3) 52.6°   (4) 15.5°   (5) 62.4°

48. A highway curve has a radius of 125 m. At what angle should the road be banked so that a car traveling at 30 m/s has no tendency to skid sideways on the road? (Hint: No tendency to skid means the frictional force is zero.)

(1) 36.3°   (2) 18.1°   (3) 52.6°   (4) 15.5°   (5) 62.4°

49. A highway curve has a radius of 125 m. At what angle should the road be banked so that a car traveling at 40 m/s has no tendency to skid sideways on the road? (Hint: No tendency to skid means the frictional force is zero.)

(1) 52.6°   (2) 18.1°   (3) 36.3°   (4) 15.5°   (5) 62.4°

50. Near the surface of the Earth a block is released from rest 12 m above the ground. If the kinetic energy of the block is 500 J when it hits the ground, what is the mass M of the block (in kg)?

(1) 4.25   (2) 5.10   (3) 6.38   (4) 3.56   (5) 8.23

51. Near the surface of the Earth a block is released from rest 12 m above the ground. If the kinetic energy of the block is 600 J when it hits the ground, what is the mass M of the block (in kg)?

(1) 5.10   (2) 4.25   (3) 6.38   (4) 3.56   (5) 8.23

52. Near the surface of the Earth a block is released from rest 12 m above the ground. If the kinetic energy of the block is 750 J when it hits the ground, what is the mass M of the block (in kg)?

(1) 6.38   (2) 4.25   (3) 5.10   (4) 3.56   (5) 8.23

53. Ice fishing equipment weighing 3,200 N is pulled at a constant speed $v = 0.6$ m/s across a frozen lake by means of a horizontal rope. If the coefficient of kinetic friction is 0.05, what is the work done (in J) by the fisherman in pulling the equipment a distance of 500 m?

(1) 8.0×10^4 (2) 6.4×10^4 (3) 9.6×10^4 (4) 3.2×10^4 (5) 7.5×10^5

54. Ice fishing equipment weighing 3,200 N is pulled at a constant speed $v = 0.6$ m/s across a frozen lake by means of a horizontal rope. If the coefficient of kinetic friction is 0.04, what is the work done (in J) by the fisherman in pulling the equipment a distance of 500 m?

(1) 6.4×10^4 (2) 8.0×10^4 (3) 9.6×10^4 (4) 3.2×10^4 (5) 7.5×10^5

55. Ice fishing equipment weighing 3,200 N is pulled at a constant speed $v = 0.6$ m/s across a frozen lake by means of a horizontal rope. If the coefficient of kinetic friction is 0.06, what is the work done (in J) by the fisherman in pulling the equipment a distance of 500 m?

(1) 9.6×10^4 (2) 8.0×10^4 (3) 6.4×10^4 (4) 3.2×10^4 (5) 7.5×10^5

56. Near the surface of the Earth a block of mass M is sliding down an incline with angle $\theta_1 = 30°$ as shown in the figure. Initially the block is at a height $h = 2.0$ m with a speed of 12 m/s. The block slides down the incline, across the level surface, and up an incline with angle $\theta_2 = 45°$. If all the surfaces are frictionless, what maximum height H will the block reach?
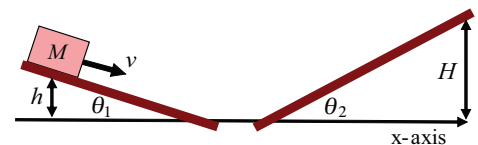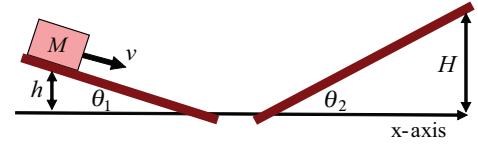

(1) 9.35 m   (2) 10.35 m   (3) 11.35 m   (4) 7.35 m   (5) 12.35 m

57. Near the surface of the Earth a block of mass M is sliding down an incline with angle $\theta_1 = 30°$ as shown in the figure. Initially the block is at a height $h = 3.0$ m with a speed of 12 m/s. The block slides down the incline, across the level surface, and up an incline with angle $\theta_2 = 45°$. If all the surfaces are frictionless, what maximum height H will the block reach?
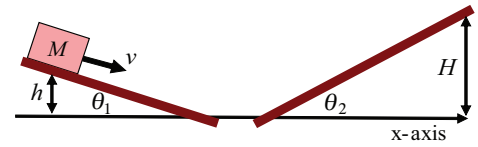
(1) 10.35 m   (2) 9.35 m   (3) 11.35 m   (4) 7.35 m   (5) 12.35 m

58. Near the surface of the Earth a block of mass M is sliding down an incline with angle $\theta_1 = 30°$ as shown in the figure. Initially the block is at a height $h = 4.0$ m with a speed of 12 m/s. The block slides down the incline, across the level surface, and up an incline with angle $\theta_2 = 45°$. If all the surfaces are frictionless, what maximum height H will the block reach?

(1) 11.35 m   (2) 9.35 m   (3) 10.35 m   (4) 7.35 m   (5) 12.35 m

FOLLOWING GROUPS OF QUESTIONS WILL BE SELECTED AS ONE GROUP FROM EACH TYPE
TYPE 1
Q# S 2
Q# S 3
Q# S 4
TYPE 2
Q# S 5
Q# S 6
Q# S 7
TYPE 3
Q# S 8
Q# S 9
Q# S 10
TYPE 4
Q# S 11
Q# S 12
Q# S 13
TYPE 5
Q# S 14
Q# S 15
Q# S 16
TYPE 6
Q# S 17
Q# S 18
Q# S 19
TYPE 7
Q# S 20
Q# S 21
Q# S 22
TYPE 8
Q# S 23
Q# S 24
Q# S 25
TYPE 9
Q# S 26
Q# S 27
Q# S 28
TYPE 10
Q# S 29
Q# S 30
Q# S 31
TYPE 11
Q# S 32
Q# S 33
Q# S 34
TYPE 12
Q# S 35
Q# S 36
Q# S 37
TYPE 13

Q# S 38
Q# S 39
Q# S 40
TYPE 14
Q# S 41
Q# S 42
Q# S 43
TYPE 15
Q# S 44
Q# S 45
Q# S 46
TYPE 16
Q# S 47
Q# S 48
Q# S 49
TYPE 17
Q# S 50
Q# S 51
Q# S 52
TYPE 18
Q# S 53
Q# S 54
Q# S 55
TYPE 19
Q# S 56
Q# S 57
Q# S 58