Instructor(s): *Field/Rinzler*

PHYSICS DEPARTMENT

PHY 2053 Exam 1 February 20, 2013

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 blue or black 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 $g = 9.80$ m/s^2

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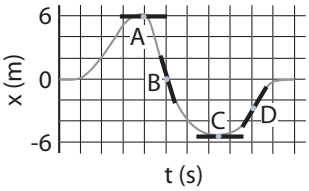
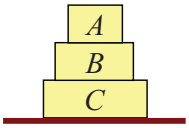
1. The curved line in the figure shows the position of an object along the x axis as a function of time. The thick straight black lines are the tangents to the curve at the points of the curve labeled A, B, C and D. At what point is the object moving with the greatest speed, and at what point is it moving with positive velocity, respectively (answering in that order)?



(1) B, D (2) A, A (3) B, A (4) A, B (5) C, A

2. Near the surface of the Earth, three blocks (A, B, and C) are at rest on a table as shown in the figure. If $M_A = 1$ kg, $M_B = 2$ kg, and $M_C = 3$ kg, what is the magnitude of the net force on block B (in N)?



(1) zero (2) 9.8 (3) 19.6 (4) 28.4 (5) 4.9

3. If vector $\vec{A} = 3\hat{x} + 1\hat{y}$ and vector $\vec{B} = -2\hat{x} + 4\hat{y}$ and vector $\vec{C} = \vec{A} + \vec{B}$, what angle does $\vec{C}$ make with the x-axis?

(1) 78.7° (2) 68.2° (3) 59.0° (4) 87.6° (5) 38.2°

4. If vector $\vec{A} = 4\hat{x} + 1\hat{y}$ and vector $\vec{B} = -2\hat{x} + 4\hat{y}$ and vector $\vec{C} = \vec{A} + \vec{B}$, what angle does $\vec{C}$ make with the x-axis?

(1) 68.2° (2) 78.7° (3) 59.0° (4) 87.6° (5) 38.2°

5. If vector $\vec{A} = 5\hat{x} + 1\hat{y}$ and vector $\vec{B} = -2\hat{x} + 4\hat{y}$ and vector $\vec{C} = \vec{A} + \vec{B}$, what angle does $\vec{C}$ make with the x-axis?

(1) 59.0° (2) 78.7° (3) 68.2° (4) 87.6° (5) 38.2°

6. At time $t = 0$ near the surface of the Earth an object is thrown straight down from a high cliff with an initial speed of 4.9 m/s. How far (in m) does it fall during the time interval from $t = 1$ s to $t = 2$ s? Ignore air resistance.

(1) 19.6 (2) 49.0 (3) 29.4 (4) 9.8 (5) 64.5

7. At time $t = 0$ near the surface of the Earth an object is thrown straight down from a high cliff with an initial speed of 4.9 m/s. How far (in m) does it fall during the time interval from $t = 1$ s to $t = 3$ s? Ignore air resistance.

(1) 49.0 (2) 19.6 (3) 29.4 (4) 9.8 (5) 64.5

8. At time $t = 0$ near the surface of the Earth an object is thrown straight down from a high cliff with an initial speed of 4.9 m/s. How far (in m) does it fall during the time interval from $t = 2$ s to $t = 3$ s? Ignore air resistance.

(1) 29.4 (2) 19.6 (3) 49.0 (4) 9.8 (5) 64.5

9. Near the surface of the Earth a ball is tossed straight up. If the ball returns to its starting point 2 seconds later, what maximum height did the ball reach (in m)? Ignore air resistance.

(1) 4.9 (2) 11.0 (3) 19.6 (4) 9.8 (5) 2.8

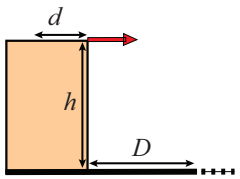
10. Near the surface of the Earth a ball is tossed straight up. If the ball returns to its starting point 3 seconds later, what maximum height did the ball reach (in m)? Ignore air resistance.

(1) 11.0 (2) 4.9 (3) 19.6 (4) 9.8 (5) 2.8

11. Near the surface of the Earth a ball is tossed straight up. If the ball returns to its starting point 4 seconds later, what maximum height did the ball reach (in m)? Ignore air resistance.

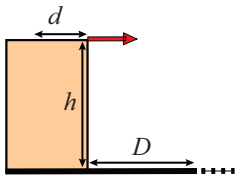
(1) 19.6 (2) 4.9 (3) 11.0 (4) 9.8 (5) 2.8

12. A remote controlled toy car accelerates from rest with constant acceleration, a, under the power of its own wheels on a horizontal balcony until it shoots off the edge of the balcony a distance $d = 2$ m from its starting point as shown in the figure. If the balcony is $h = 10$ m high, and the horizontal distance from the point it left the balcony to where the car lands on level ground is $D = 2$ m, what was the initial acceleration, a, of the car (in m/s^2)?



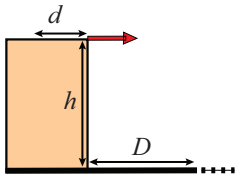
(1) 0.49 (2) 1.96 (3) 4.41 (4) 0.25 (5) 6.54

13. A remote controlled toy car accelerates from rest with constant acceleration, a, under the power of its own wheels on a horizontal balcony until it shoots off the edge of the balcony a distance $d = 2$ m from its starting point as shown in the figure. If the balcony is $h = 10$ m high, and the horizontal distance from the point it left the balcony to where the car lands on level ground is $D = 4$ m, what was the initial acceleration, a, of the car (in m/s^2)?



(1) 1.96 (2) 0.49 (3) 4.41 (4) 0.25 (5) 6.54

14. A remote controlled toy car accelerates from rest with constant acceleration, a, under the power of its own wheels on a horizontal balcony until it shoots off the edge of the balcony a distance $d = 2$ m from its starting point as shown in the figure. If the balcony is $h = 10$ m high, and the horizontal distance from the point it left the balcony to where the car lands on level ground is $D = 6$ m, what was the initial acceleration, a, of the car (in m/s^2)?



(1) 4.41 (2) 0.49 (3) 1.96 (4) 0.25 (5) 6.54

15. A descending elevator traveling at 6 m/s stops with a uniform deceleration over a distance of 10 m. A woman of mass 55 kg stands on a scale in the elevator. During the deceleration does the scale read higher or lower than her resting weight and what does the scale read (in N)?

(1) higher, 638 (2) higher, 715 (3) higher, 583 (4) lower, 583 (5) lower, 638

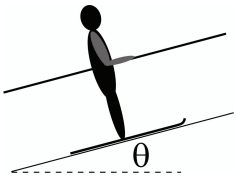
16. A descending elevator traveling at 8 m/s stops with a uniform deceleration over a distance of 10 m. A woman of mass 55 kg stands on a scale in the elevator. During the deceleration does the scale read higher or lower than her resting weight and what does the scale read (in N)?

(1) higher, 715 (2) higher, 638 (3) higher, 583 (4) lower, 583 (5) lower, 715

17. A descending elevator traveling at 4 m/s stops with a uniform deceleration over a distance of 10 m. A woman of mass 55 kg stands on a scale in the elevator. During the deceleration does the scale read higher or lower than her resting weight and what does the scale read (in N)?

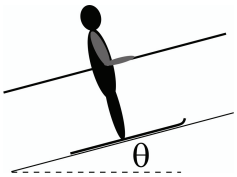
(1) higher, 583 (2) higher, 638 (3) higher, 715 (4) lower, 583 (5) lower, 638

18. A skier of mass 64 kg is being towed up a slope ($\theta = 15°$) by a towrope at a constant speed of 3 m/s as shown in the figure. If the coefficient of kinetic friction between the skies and the snow is 0.050, what is the force (in N) that the towrope applies to the skier?



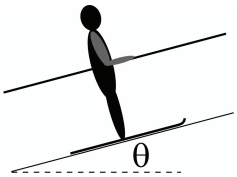
(1) 192.6 (2) 223.6 (3) 244.0 (4) 162 .5 (5) 287.7

19. A skier of mass 64 kg is being towed up a slope ($\theta = 18°$) by a towrope at a constant speed of 3 m/s as shown in the figure. If the coefficient of kinetic friction between the skies and the snow is 0.050, what is the force (in N) that the towrope applies to the skier?



(1) 223.6 (2) 192.6 (3) 244.0 (4) 162 .5 (5) 287.7

20. A skier of mass 64 kg is being towed up a slope ($\theta = 20°$) by a towrope at a constant speed of 3 m/s as shown in the figure. If the coefficient of kinetic friction between the skies and the snow is 0.050, what is the force (in N) that the towrope applies to the skier?



(1) 244.0 (2) 192.6 (3) 223.6 (4) 162 .5 (5) 287.7

21. A truck loses its brakes while rolling down a long straight grade making an angle with the horizontal of 14°. If the truck is moving at 10 m/s when it is 500 m (measured along the road) from the bottom of the hill, what is the trucks speed (in m/s) when it passes the bottom? Ignore friction and air resistance.

(1) 49.7 (2) 57.2 (3) 69.8 (4) 42.1 (5) 74.6

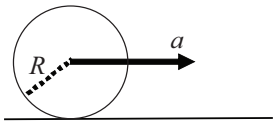
22. A truck loses its brakes while rolling down a long straight grade making an angle with the horizontal of 14°. If the truck is moving at 30 m/s when it is 500 m (measured along the road) from the bottom of the hill, what is the trucks speed (in m/s) when it passes the bottom? Ignore friction and air resistance.

(1) 57.2 (2) 49.7 (3) 69.8 (4) 42.1 (5) 74.6

23. A truck loses its brakes while rolling down a long straight grade making an angle with the horizontal of 14°. If the truck is moving at 50 m/s when it is 500 m (measured along the road) from the bottom of the hill, what is the trucks speed (in m/s) when it passes the bottom? Ignore friction and air resistance.

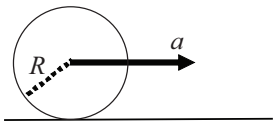
(1) 69.8 (2) 49.7 (3) 57.2 (4) 42.1 (5) 74.6

24. Starting from rest at time $t = 0$, a circular wheel with radius $R = 3$ m is pulled to the right along a horizontal surface at a constant acceleration of $a = 2$ m/s^2 as shown in the figure. If the wheel rolls without slipping, how long (in s) does it take the wheel to make 6 revolutions?



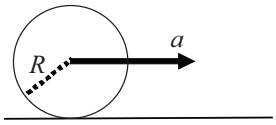
(1) 10.6 (2) 12.3 (3) 13.7 (4) 5.3 (5) 15.1

25. Starting from rest at time $t = 0$, a circular wheel with radius $R = 3$ m is pulled to the right along a horizontal surface at a constant acceleration of $a = 2$ m/s^2 as shown in the figure. If the wheel rolls without slipping, how long (in s) does it take the wheel to make 8 revolutions?



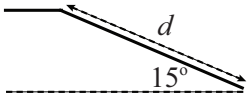
(1) 12.3 (2) 10.6 (3) 13.7 (4) 5.3 (5) 15.1

26. Starting from rest at time $t = 0$, a circular wheel with radius $R = 3$ m is pulled to the right along a horizontal surface at a constant acceleration of $a = 2$ m/s^2 as shown in the figure. If the wheel rolls without slipping, how long (in s) does it take the wheel to make 10 revolutions?



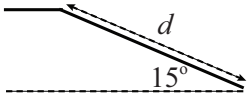
(1) 13.7 (2) 10.6 (3) 12.3 (4) 5.3 (5) 15.1

27. A hill makes an angle of 15° with the horizontal. If a 50-kg jogger runs a distance of $d = 200$ m down the hill as shown in the figure, how much work is done by gravity on the jogger (in J)?



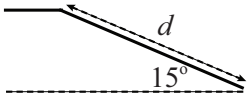
(1) 25,364 (2) 38,046 (3) 50,729 (4) $-25,364$ (5) $-38,046$

28. A hill makes an angle of 15° with the horizontal. If a 50-kg jogger runs a distance of $d = 300$ m down the hill as shown in the figure, how much work is done by gravity on the jogger (in J)?



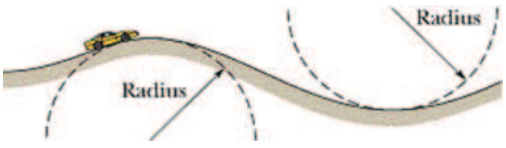
(1) 38,046 (2) 25,364 (3) 50,729 (4) $-25,364$ (5) $-38,046$

29. A hill makes an angle of 15° with the horizontal. If a 50-kg jogger runs a distance of $d = 400$ m down the hill as shown in the figure, how much work is done by gravity on the jogger (in J)?



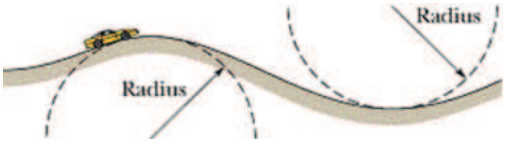
(1) 50,729 (2) 25,364 (3) 38,046 (4) $-25,364$ (5) $-38,046$

30. A man with a weight of 100 N drives a car at speed $v_1 = 40$ m/s over a circular hill and then into a circular valley with the same radius, but with speed v_2, as shown in the figure. At the top of the hill, the normal force on the man from the car seat is zero. If the magnitude of the normal force on the man from the seat when the car passes through the bottom of the valley is 500 N, what is the speed v_2 (in m/s)?



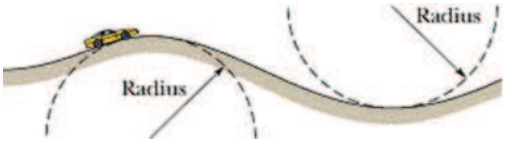
(1) 80 (2) 120 (3) 160 (4) 65 (5) 50

31. A man with a weight of 100 N drives a car at speed $v_1 = 40$ m/s over a circular hill and then into a circular valley with the same radius, but with speed v_2, as shown in the figure. At the top of the hill, the normal force on the man from the car seat is zero. If the magnitude of the normal force on the man from the seat when the car passes through the bottom of the valley is 1,000 N, what is the speed v_2 (in m/s)?



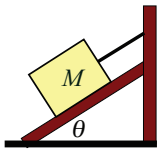
(1) 120 (2) 80 (3) 160 (4) 65 (5) 50

32. A man with a weight of 100 N drives a car at speed $v_1 = 40$ m/s over a circular hill and then into a circular valley with the same radius, but with speed v_2, as shown in the figure. At the top of the hill, the normal force on the man from the car seat is zero. If the magnitude of the normal force on the man from the seat when the car passes through the bottom of the valley is 1,700 N, what is the speed v_2 (in m/s)?



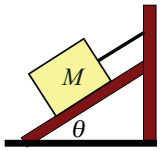
(1) 160 (2) 120 (3) 80 (4) 65 (5) 50

33. Near the surface of the Earth a block of mass $M = 4$ kg is held at rest on a plane inclined at an angle $\theta = 30°$ by a rope attached to the wall, as shown in the figure. The rope was originally slack and the block was slowly allowed to slide down the ramp until the minimum tension developed in the rope. If the coefficient of static friction between the block and the incline plane is $\mu_s = 0.4$, what is the tension of the rope (in N)?



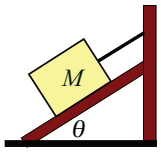
(1) 6.0 (2) 16.6 (3) 26.1 (4) 1.8 (5) 9.8

34. Near the surface of the Earth a block of mass $M = 4$ kg is held at rest on a plane inclined at an angle $\theta = 45°$ by a rope attached to the wall, as shown in the figure. The rope was originally slack and the block was slowly allowed to slide down the ramp until the minimum tension developed in the rope. If the coefficient of static friction between the block and the incline plane is $\mu_s = 0.4$, what is the tension of the rope (in N)?



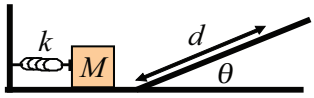
(1) 16.6 (2) 6.0 (3) 26.1 (4) 1.8 (5) 9.8

35. Near the surface of the Earth a block of mass $M = 4$ kg is held at rest on a plane inclined at an angle $\theta = 60°$ by a rope attached to the wall, as shown in the figure. The rope was originally slack and the block was slowly allowed to slide down the ramp until the minimum tension developed in the rope. If the coefficient of static friction between the block and the incline plane is $\mu_s = 0.4$, what is the tension of the rope (in N)?



(1) 26.1 (2) 6.0 (3) 16.6 (4) 1.8 (5) 9.8

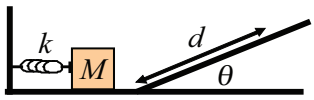
36. Near the surface of the Earth, an ideal spring with spring constant k is on a frictionless horizontal surface at the base of a frictionless inclined plane as shown in the figure. A block with mass $M = 0.5$ kg is pressed against the spring, compressing it 6 cm from its equilibrium position. The block is then released and is not attached to the spring. If the block slides a distance $d = 2$ m up the inclined plane with $\theta = 30°$ before coming to rest and then sliding back down, what is the spring constant k (in N/m)?



(1) 2,722 (2) 3,267 (3) 3,811 (4) 1,958 (5) 4,611

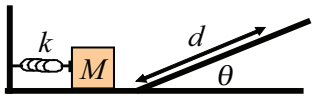
77777

37. Near the surface of the Earth, an ideal spring with spring constant k is on a frictionless horizontal surface at the base of a frictionless inclined plane as shown in the figure. A block with mass $M = 0.6$ kg is pressed against the spring, compressing it 6 cm from its equilibrium position. The block is then released and is not attached to the spring. If the block slides a distance $d = 2$ m up the inclined plane with $\theta = 30°$ before coming to rest and then sliding back down, what is the spring constant k (in N/m)?



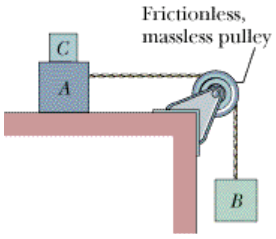
(1) 3,267 (2) 2,722 (3) 3,811 (4) 1,958 (5) 4,611

38. Near the surface of the Earth, an ideal spring with spring constant k is on a frictionless horizontal surface at the base of a frictionless inclined plane as shown in the figure. A block with mass $M = 0.7$ kg is pressed against the spring, compressing it 6 cm from its equilibrium position. The block is then released and is not attached to the spring. If the block slides a distance $d = 2$ m up the inclined plane with $\theta = 30°$ before coming to rest and then sliding back down, what is the spring constant k (in N/m)?



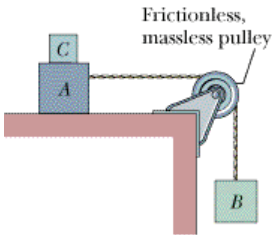
(1) 3,811 (2) 2,722 (3) 3,267 (4) 1,958 (5) 4,611

39. In the figure, blocks A and B have a mass of 30 kg and 10 kg, respectively. If the static coefficient of friction μ_s between block A and the table is 0.20, what is the minimum mass of block C (in kg) to keep block A from sliding?



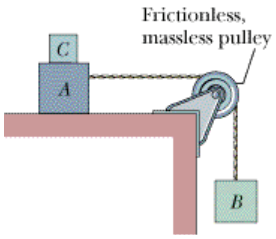
(1) 20
(2) 30
(3) 10
(4) 5
(5) 40

40. In the figure, blocks A and B have a mass of 20 kg and 10 kg, respectively. If the static coefficient of friction μ_s between block A and the table is 0.20, what is the minimum mass of block C (in kg) to keep block A from sliding?



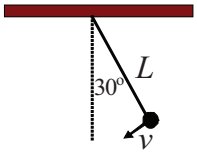
(1) 30
(2) 20
(3) 10
(4) 5
(5) 40

41. In the figure, blocks A and B have a mass of 40 kg and 10 kg, respectively. If the static coefficient of friction μ_s between block A and the table is 0.20, what is the minimum mass of block C (in kg) to keep block A from sliding?



(1) 10
(2) 20
(3) 30
(4) 5
(5) 40

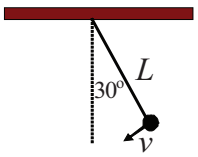
42. A ball of mass M is connected to a thin string with negligible mass and length $L = 2.0$ m. It is released by a push when the string is at an angle of 30° from the vertical as shown in the figure. If the initial tangential speed of the suspended mass is 2.5 m/s when at the release point, what maximum angle will the string make with the vertical during its swing?



(1) 45.0° (2) 40.2° (3) 50.5° (4) 90.0° (5) 30.0°

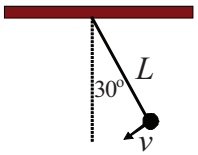
77777

43. A ball of mass M is connected to a thin string with negligible mass and length $L = 2.0$ m. It is released by a push when the string is at an angle of 30° from the vertical as shown in the figure. If the initial tangential speed of the suspended mass is 2.0 m/s when at the release point, what maximum angle will the string make with the vertical during its swing?



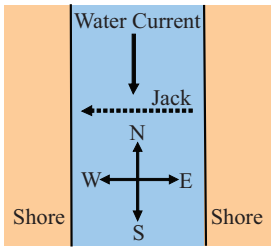
(1) 40.2° (2) 45.0° (3) 50.5° (4) 90.0° (5) 30.0°

44. A ball of mass M is connected to a thin string with negligible mass and length $L = 2.0$ m. It is released by a push when the string is at an angle of 30° from the vertical as shown in the figure. If the initial tangential speed of the suspended mass is 3.0 m/s when at the release point, what maximum angle will the string make with the vertical during its swing?



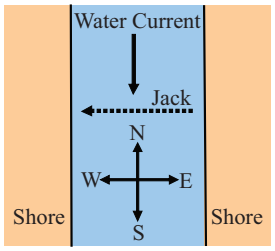
(1) 50.5° (2) 45.0° (3) 40.2° (4) 90.0° (5) 30.0°

45. Jack wants to row directly across a river from the east shore to a point on the west shore, as shown in the figure. Due to the current he could not aim directly for that point. The width of the river is 500 m and the current flows from north to south at 2.0 m/s. The trip takes Jack 4 minutes. At what speed (in m/s) with respect to the still water is Jack able to row?



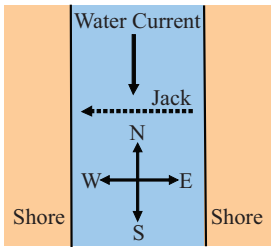
(1) 2.89
(2) 2.43
(3) 2.26
(4) 2.08
(5) 1.39

46. Jack wants to row directly across a river from the east shore to a point on the west shore, as shown in the figure. Due to the current he could not aim directly for that point. The width of the river is 500 m and the current flows from north to south at 2.0 m/s. The trip takes Jack 6 minutes. At what speed (in m/s) with respect to the still water is Jack able to row?



(1) 2.43
(2) 2.89
(3) 2.26
(4) 2.08
(5) 1.39

47. Jack wants to row directly across a river from the east shore to a point on the west shore, as shown in the figure. Due to the current he could not aim directly for that point. The width of the river is 500 m and the current flows from north to south at 2.0 m/s. The trip takes Jack 8 minutes. At what speed (in m/s) with respect to the still water is Jack able to row?



(1) 2.26
(2) 2.89
(3) 2.43
(4) 2.08
(5) 1.39

48. A potter's wheel rotates from rest to 240 rpm in a time of 3 seconds. Assuming constant angular acceleration, how many revolutions does the wheel make during this time interval?

(1) 6 (2) 9 (3) 12 (4) 3 (5) 10

49. A potter's wheel rotates from rest to 360 rpm in a time of 3 seconds. Assuming constant angular acceleration, how many revolutions does the wheel make during this time interval?

(1) 9 (2) 6 (3) 12 (4) 3 (5) 10

50. A potter's wheel rotates from rest to 480 rpm in a time of 3 seconds. Assuming constant angular acceleration, how many revolutions does the wheel make during this time interval?

(1) 12 (2) 6 (3) 9 (4) 3 (5) 10

51. A projectile is fired straight upward from Earth's surface with a speed that is 0.816 times the escape speed. If R_E is the radius of Earth, what is the highest altitude reached measured from the surface of the Earth?

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

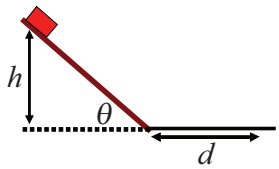
52. A projectile is fired straight upward from Earth's surface with a speed that is 0.866 times the escape speed. If R_E is the radius of Earth, what is the highest altitude reached measured from the surface of the Earth?

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

53. A projectile is fired straight upward from Earth's surface with a speed that is 0.894 times the escape speed. If R_E is the radius of Earth, what is the highest altitude reached measured from the surface of the Earth?

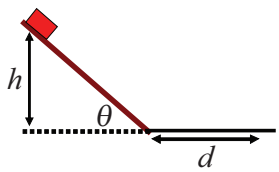
(1) $4R_E$ (2) $2R_E$ (3) $3R_E$ (4) R_E (5) $5R_E$

54. Near the surface of the Earth a block of mass M is released from rest at a height h = 10 m on a frictionless incline as shown in the figure. The block slides down the frictionless incline to reach a flat horizontal surface. If the kinetic coefficient of friction between the block and the horizontal surface is 0.2, how far (in m) will the block slide along the horizontal surface before coming to rest?



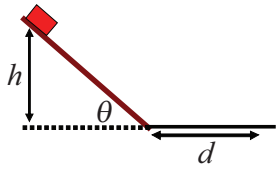
(1) 50 (2) 25 (3) 20 (4) 10 (5) 5

55. Near the surface of the Earth a block of mass M is released from rest at a height h = 10 m on a frictionless incline as shown in the figure. The block slides down the frictionless incline to reach a flat horizontal surface. If the kinetic coefficient of friction between the block and the horizontal surface is 0.4, how far (in m) will the block slide along the horizontal surface before coming to rest?



(1) 25 (2) 50 (3) 20 (4) 10 (5) 5

56. Near the surface of the Earth a block of mass M is released from rest at a height h = 10 m on a frictionless incline as shown in the figure. The block slides down the frictionless incline to reach a flat horizontal surface. If the kinetic coefficient of friction between the block and the horizontal surface is 0.5, how far (in m) will the block slide along the horizontal surface before coming to rest?



(1) 20 (2) 50 (3) 25 (4) 10 (5) 5

FOLLOWING GROUPS OF QUESTIONS WILL BE SELECTED AS ONE GROUP FROM EACH TYPE
TYPE 1
Q# S 3

Q# S 4
Q# S 5
TYPE 2
Q# S 6
Q# S 7
Q# S 8
TYPE 3
Q# S 9
Q# S 10
Q# S 11
TYPE 4
Q# S 12
Q# S 13
Q# S 14
TYPE 5
Q# S 15
Q# S 16
Q# S 17
TYPE 6
Q# S 18
Q# S 19
Q# S 20
TYPE 7
Q# S 21
Q# S 22
Q# S 23
TYPE 8
Q# S 24
Q# S 25
Q# S 26
TYPE 9
Q# S 27
Q# S 28
Q# S 29
TYPE 10
Q# S 30
Q# S 31
Q# S 32
TYPE 11
Q# S 33
Q# S 34
Q# S 35
TYPE 12
Q# S 36
Q# S 37
Q# S 38
TYPE 13
Q# S 39
Q# S 40
Q# S 41
TYPE 14
Q# S 42
Q# S 43
Q# S 44
TYPE 15
Q# S 45
Q# S 46
Q# S 47
TYPE 16
Q# S 48
Q# S 49
Q# S 50
TYPE 17
Q# S 51
Q# S 52
Q# S 53
TYPE 18
Q# S 54
Q# S 55
Q# S 56