Instructor(s): *Field/Furic*

PHYSICS DEPARTMENT

PHY 2053 Exam 1 October 5, 2011

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. If vector $\vec{A} = 3\hat{x} - 4\hat{y}$ and vector $\vec{B} = 2\hat{x} + 5\hat{y}$, what is $\dfrac{|\vec{A} + \vec{B}|}{|\vec{A}| + |\vec{B}|}$?

(1) 0.49 (2) 1.0 (3) 0.96 (4) 1.2 (5) 0.65

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

(1) 0.65 (2) 1.0 (3) 0.49 (4) 1.2 (5) 0.96

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

(1) 0.96 (2) 1.0 (3) 0.49 (4) 1.2 (5) 0.65

4. A car travels 40 kilometers at a constant speed of 10 km/h and then travels 80 kilometers at a constant speed of 40 km/h. The average speed of the car for this 120-km trip is:

(1) 20 km/h (2) 24 km/h (3) 30 km/h (4) 15 km/h (5) 35 km/h

5. A car travels 40 kilometers at a constant speed of 10 km/h and then travels 80 kilometers at a constant speed of 80 km/h. The average speed of the car for this 120-km trip is:

(1) 24 km/h (2) 20 km/h (3) 30 km/h (4) 15 km/h (5) 40 km/h

6. A car travels 20 kilometers at a constant speed of 10 km/h and then travels 100 kilometers at a constant speed of 50 km/h. The average speed of the car for this 120-km trip is:

(1) 30 km/h (2) 24 km/h (3) 20 km/h (4) 15 km/h (5) 35 km/h

7. Two automobiles are moving at a constant speed in the same direction along the positive x-axis. One automobile is moving 20 km/h faster than the other. If the faster automobile is 160 kilometers behind the slower automobile, they will meet in:

(1) 8.0 h (2) 4.0 h (3) 2.0 h (4) 12.0 h (5) 16.0 h

8. Two automobiles are moving at a constant speed in the same direction along the positive x-axis. One automobile is moving 40 km/h faster than the other. If the faster automobile is 160 kilometers behind the slower automobile, they will meet in:

(1) 4.0 h (2) 8.0 h (3) 2.0 h (4) 12.0 h (5) 16.0 h

9. Two automobiles are moving at a constant speed in the same direction along the positive x-axis. One automobile is moving 80 km/h faster than the other. If the faster automobile is 160 kilometers behind the slower automobile, they will meet in:

(1) 2.0 h (2) 8.0 h (3) 4.0 h (4) 12.0 h (5) 16.0 h

10. 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 $t = 2$ s?

(1) 14.7 m (2) 9.8 m (3) 34.3 m (4) 19.6 m (5) 24.5 m

11. 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 $t = 3$ s?

(1) 24.5 m (2) 9.8 m (3) 14.7 m (4) 19.6 m (5) 34.3 m

12. 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 $t = 4$ s?

(1) 34.3 m (2) 9.8 m (3) 14.7 m (4) 19.6 m (5) 24.5 m

13. Near the surface of the Earth a suspension bridge is a height H above the level base of a gorge. A stone is thrown or dropped from the bridge. Ignore air resistance. If you drop the stone from rest, it takes 2 seconds for it to fall to the base of the gorge. If you throw the same stone straight down with a speed of 10.0 m/s, how long (in s) before it hits the ground?

(1) 1.22 (2) 2.15 (3) 0.41 (4) 1.75 (5) 0.83

14. Near the surface of the Earth a suspension bridge is a height H above the level base of a gorge. A stone is thrown or dropped from the bridge. Ignore air resistance. If you drop the stone from rest, it takes 1 second for it to fall to the base of the gorge. If you throw the same stone straight down with a speed of 10.0 m/s, how long (in s) before it hits the ground?

(1) 0.41 (2) 2.15 (3) 1.22 (4) 0.23 (5) 0.83

15. Near the surface of the Earth a suspension bridge is a height H above the level base of a gorge. A stone is thrown or dropped from the bridge. Ignore air resistance. If you drop the stone from rest it takes 3 seconds for it to fall to the base of the gorge. If you throw the same stone straight down with a speed of 10.0 m/s, how long (in s) before it hits the ground?

(1) 2.15 (2) 0.41 (3) 1.22 (4) 1.75 (5) 0.83

16. A car is driving directly north on the freeway at a speed of 110 km/h and a truck is leaving the freeway driving 80 km/h in a direction that is 35° west of north. What is the magnitude of the velocity (in km/h) of the truck relative to the car?

(1) 63.9 (2) 72.1 (3) 85.5 (4) 58.7 (5) 92.3

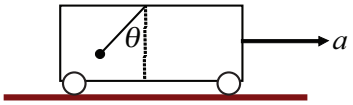
17. A car is driving directly north on the freeway at a speed of 110 km/h and a truck is leaving the freeway driving 70 km/h in a direction that is 40° west of north. What is the magnitude of the velocity (in km/h) of the truck relative to the car?

(1) 72.1 (2) 63.9 (3) 85.5 (4) 58.7 (5) 92.3

18. A car is driving directly north on the freeway at a speed of 110 km/h and a truck is leaving the freeway driving 85 km/h in a direction that is 50° west of north. What is the magnitude of the velocity (in km/h) of the truck relative to the car?

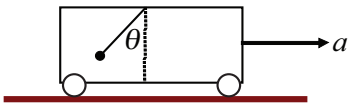
(1) 85.5 (2) 72.1 (3) 63.9 (4) 58.7 (5) 92.3

19. Consider a mass M 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 of $a = 2$ m/s^2 as shown in the figure, causing the mass to hang at an angle θ with the vertical. What is the angle θ?



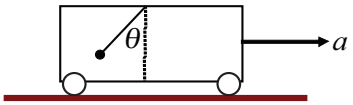
(1) 11.5° (2) 17.0° (3) 22.2° (4) 30° (5) 45°

20. Consider a mass M 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 of $a = 3$ m/s^2 as shown in the figure, causing the mass to hang at an angle θ with the vertical. What is the angle θ?



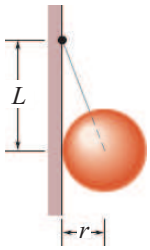
(1) 17.0° (2) 11.5° (3) 22.2° (4) 30° (5) 45°

21. Consider a mass M 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 of $a = 4$ m/s^2 as shown in the figure, causing the mass to hang at an angle θ with the vertical. What is the angle θ?



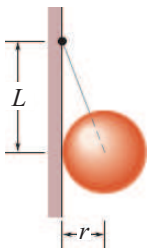
(1) 22.2° (2) 17.0° (3) 11.5° (4) 30° (5) 45°

22. In the figure, a uniform sphere with a weight of 6 N and radius r is held in place by a massless rope attached to a frictionless wall a vertical distance L above the center of the sphere. If $r = L/2$, what is the magnitude of the force on the sphere from the wall?



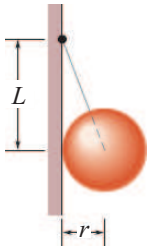
(1) 3 N
(2) 5 N
(3) 2 N
(4) 4 N
(5) 1 N

23. In the figure, a uniform sphere with a weight of 6 N and radius r is held in place by a massless rope attached to a frictionless wall a vertical distance L above the center of the sphere. If $r = L/3$, what is the magnitude of the force on the sphere from the wall?



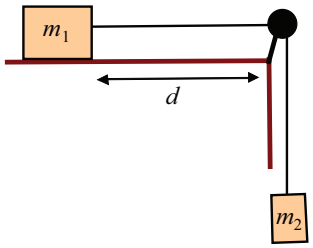
(1) 2 N
(2) 5 N
(3) 3 N
(4) 4 N
(5) 1 N

24. In the figure, a uniform sphere with a weight of 6 N and radius r is held in place by a massless rope attached to a frictionless wall a vertical distance L above the center of the sphere. If $r = 2L/3$, what is the magnitude of the force on the sphere from the wall?



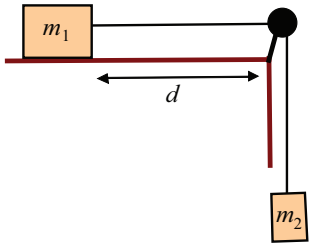
(1) 4 N
(2) 5 N
(3) 2 N
(4) 3 N
(5) 1 N

25. Near the surface of the Earth a block of mass $m_1 = 3.0$ kg rests on a frictionless horizontal surface a distance $d = 9.8$ m from the end of the table as shown in the figure. A second block of mass $m_2 = 2.0$ kg hangs on an ideal cord of negligible mass that runs over an ideal pulley and then is connected to the first mass. If the blocks are released from rest, how long (in s) does it take for the first block to reach the end of the table?



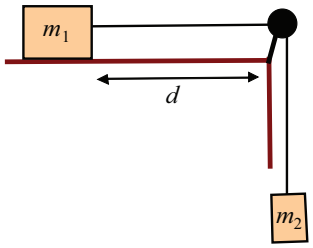
(1) 2.24 (2) 2.83 (3) 2.45 (4) 2.05 (5) 1.85

26. Near the surface of the Earth a block of mass $m_1 = 3.0$ kg rests on a frictionless horizontal surface a distance $d = 9.8$ m from the end of the table as shown in the figure. A second block of mass $m_2 = 1.0$ kg hangs on an ideal cord of negligible mass that runs over an ideal pulley and then is connected to the first mass. If the blocks are released from rest, how long (in s) does it take for the first block to reach the end of the table?



(1) 2.83 (2) 2.24 (3) 2.45 (4) 2.05 (5) 1.85

27. Near the surface of the Earth a block of mass $m_1 = 4.0$ kg rests on a frictionless horizontal surface a distance $d = 9.8$ m from the end of the table as shown in the figure. A second block of mass $m_2 = 2.0$ kg hangs on an ideal cord of negligible mass that runs over an ideal pulley and then is connected to the first mass. If the blocks are released from rest, how long (in s) does it take for the first block to reach the end of the table?



(1) 2.45 (2) 2.83 (3) 2.24 (4) 2.05 (5) 1.85

28. A rocket is fired vertically from rest on the surface of the Earth. It has a net acceleration of 17.5 m/s^2. After 1.5 s, its fuel is exhausted and its only acceleration is due to gravity. Ignoring air resistance, what is the speed (in m/s) of the rocket when it arrives back at its starting point? Assume that the rocket is always near the surface of the Earth.

(1) 32.8 (2) 43.7 (3) 36.6 (4) 28.3 (5) 48.8

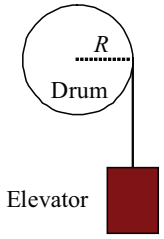
29. A rocket is fired vertically from rest on the surface of the Earth. It has a net acceleration of 20.0 m/s^2. After 2.0 s, its fuel is exhausted and its only acceleration is due to gravity. Ignoring air resistance, what is the speed (in m/s) of the rocket when it arrives back at its starting point? Assume that the rocket is always near the surface of the Earth.

(1) 48.8 (2) 32.8 (3) 36.6 (4) 28.3 (5) 43.7

30. A rocket is fired vertically from rest on the surface of the Earth. It has a net acceleration of 20.0 m/s^2. After 1.5 s, its fuel is exhausted and its only acceleration is due to gravity. Ignoring air resistance, what is the speed (in m/s) of the rocket when it arrives back at its starting point? Assume that the rocket is always near the surface of the Earth.

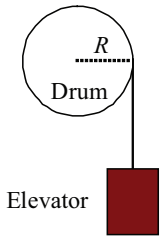
(1) 36.6 (2) 43.7 (3) 32.8 (4) 28.3 (5) 48.8

31. An elevator cable winds on a drum of radius R that is connected to a motor. The elevator is moving down at a speed of 1.0 m/s and the angular speed of the drum is 2.0 rad/s? If the elevator moves down 6.28 m, how many revolutions has the drum made?



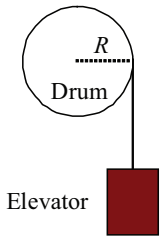
(1) 2
(2) 3
(3) 4
(4) 5
(5) 1

32. An elevator cable winds on a drum of radius R that is connected to a motor. The elevator is moving down at a speed of 1.0 m/s and the angular speed of the drum is 2.0 rad/s? If the elevator moves down 9.42 m, how many revolutions has the drum made?



(1) 3
(2) 2
(3) 4
(4) 5
(5) 1

33. An elevator cable winds on a drum of radius R that is connected to a motor. The elevator is moving down at a speed of 1.0 m/s and the angular speed of the drum is 2.0 rad/s? If the elevator moves down 12.57 m, how many revolutions has the drum made?



(1) 4
(2) 3
(3) 2
(4) 5
(5) 1

34. A car is traveling in a circle with radius $R = 200$ m on a flat highway. If the maximum speed the car can travel around the curve without slipping is 30 m/s, what is the static coefficient of friction between the car and the highway?

(1) 0.459 (2) 0.367 (3) 0.653 (4) 0.283 (5) 0.191

35. A car is traveling in a circle with radius $R = 250$ m on a flat highway. If the maximum speed the car can travel around the curve without slipping is 30 m/s, what is the static coefficient of friction between the car and the highway?

(1) 0.367 (2) 0.653 (3) 0.459 (4) 0.283 (5) 0.191

36. A car is traveling in a circle with radius $R = 250$ m on a flat highway. If the maximum speed the car can travel around the curve without slipping is 40 m/s, what is the static coefficient of friction between the car and the highway?

(1) 0.653 (2) 0.367 (3) 0.459 (4) 0.283 (5) 0.079

37. A race car accelerates uniformly from a speed of 40 m/s to a speed of 60 m/s in 5 seconds while traveling around a circular track of radius 625 m. When the car reaches a speed of 45 m/s what is the magnitude of its total acceleration (in m/s^2)?

(1) 5.15 (2) 5.66 (3) 6.28 (4) 4.0 (5) 4.87

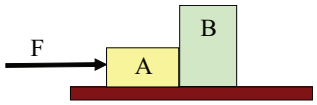
38. A race car accelerates uniformly from a speed of 40 m/s to a speed of 60 m/s in 5 seconds while traveling around a circular track of radius 625 m. When the car reaches a speed of 50 m/s what is the magnitude of its total acceleration (in m/s^2)?

(1) 5.66 (2) 5.15 (3) 6.28 (4) 4.0 (5) 4.87

39. A race car accelerates uniformly from a speed of 40 m/s to a speed of 60 m/s in 5 seconds while traveling around a circular track of radius 625 m. When the car reaches a speed of 55 m/s what is the magnitude of its total acceleration (in m/s^2)?

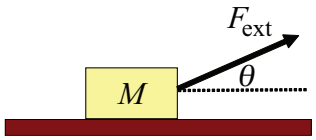
(1) 6.28 (2) 5.66 (3) 5.15 (4) 4.0 (5) 4.87

40. A constant horizontal force, F, is applied to block A with mass M_A, which pushes against block B with mass M_B as shown in the figure. If the surface is frictionless, what is the magnitude of the force that block A exerts on block B?



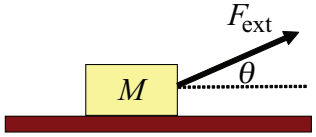
(1) $M_BF/(M_A+M_B)$ (2) $M_AF/(M_A+M_B)$ (3) M_AF/M_B (4) M_BF/M_A (5) F

41. Near the surface of the Earth, a block of mass $M = 2$ kg slides along the floor while an external force F_{ext} is applied at an upward angle $\theta = 25°$? If the coefficient of kinetic friction between the block and the floor is 0.4, and the magnitude of the external force is 12 N, what is the acceleration of the block (in m/s^2)?



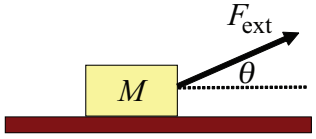
(1) 2.53 (2) 3.16 (3) 1.10 (4) 4.42 (5) 1.89

42. Near the surface of the Earth, a block of mass $M = 2$ kg slides along the floor while an external force F_{ext} is applied at an upward angle $\theta = 30°$? If the coefficient of kinetic friction between the block and the floor is 0.3, and the magnitude of the external force is 12 N, what is the acceleration of the block (in m/s^2)?



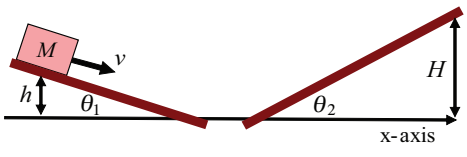
(1) 3.16 (2) 1.10 (3) 2.53 (4) 4.42 (5) 1.89

43. Near the surface of the Earth, a block of mass $M = 2$ kg slides along the floor while an external force F_{ext} is applied at an upward angle $\theta = 35°$? If the coefficient of kinetic friction between the block and the floor is 0.6, and the magnitude of the external force is 12 N, what is the acceleration of the block (in m/s^2)?



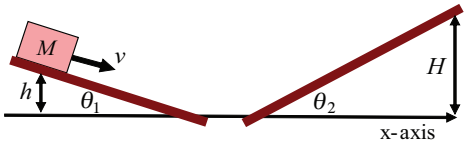
(1) 1.10 (2) 3.16 (3) 2.53 (4) 4.42 (5) 1.89

44. 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 9.8 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?



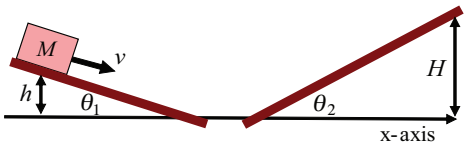
(1) 6.9 m (2) 4.9 m (3) 5.9 m (4) 8.9 m (5) 7.9 m

45. 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 9.8 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?



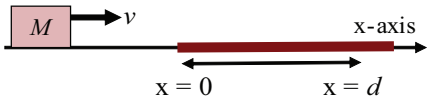
(1) 7.9 m (2) 4.9 m (3) 5.9 m (4) 8.9 m (5) 6.9 m

46. 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 $h = 1.0$ m with a speed of 9.8 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?



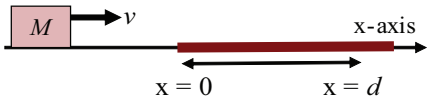
(1) 5.9 m (2) 4.9 m (3) 6.9 m (4) 8.9 m (5) 7.9 m

47. Near the surface of the Earth a block of mass M and initial velocity 9.8 m/s is sliding to the right along the (negative) x-axis as shown in the figure. The surface is frictionless for $x < 0$. If for $x \geq 0$ the block encounters friction and stops at $x = 9.8$ m, what is the kinetic coefficient of friction?



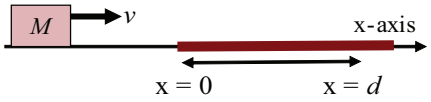
(1) 0.5 (2) 0.25 (3) 0.75 (4) 0.6 (5) 0.2

48. Near the surface of the Earth a block of mass M and initial velocity 9.8 m/s is sliding to the right along the (negative) x-axis as shown in the figure. The surface is frictionless for $x < 0$. If for $x \geq 0$ the block encounters friction and stops at $x = 19.6$ m, what is the kinetic coefficient of friction?



(1) 0.25 (2) 0.5 (3) 0.75 (4) 0.6 (5) 0.2

49. Near the surface of the Earth a block of mass M and initial velocity 9.8 m/s is sliding to the right along the (negative) x-axis as shown in the figure. The surface is frictionless for $x < 0$. If for $x \geq 0$ the block encounters friction and stops at $x = 6.53$ m, what is the kinetic coefficient of friction?



(1) 0.75 (2) 0.25 (3) 0.5 (4) 0.6 (5) 0.2

50. Near the surface of the Earth a stone of 2-kg mass sits at rest on an elastic spring (*i.e.,* Hooke's Law spring) which is compressed a distance of 2 cm by the stone. What is the spring constant k (in N/m)?

(1) 980 (2) 490 (3) 245 (4) 1280 (5) 625

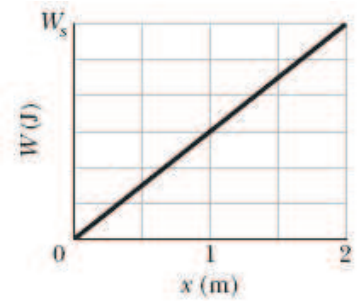
51. Near the surface of the Earth a stone of 2-kg mass sits at rest on an elastic spring (*i.e.,* Hooke's Law spring) which is compressed a distance of 4 cm by the stone. What is the spring constant k (in N/m)?

(1) 490 (2) 980 (3) 245 (4) 1280 (5) 625

52. Near the surface of the Earth a stone of 2-kg mass sits at rest on an elastic spring (*i.e.,* Hooke's Law spring) which is compressed a distance of 8 cm by the stone. What is the spring constant k (in N/m)?

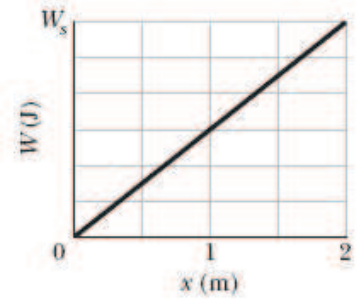
(1) 245 (2) 490 (3) 980 (4) 1280 (5) 625

53. A can of bolts and nuts is pushed 2 m along an x axis by a broom along the greasy (frictionless) floor of a car repair shop in a version of shuffleboard. The figure gives the work W done on the can by the constant horizontal force from the broom, versus the can's position x. The scale of the figure's vertical axis is set by $W_s = 10$ J. What is the magnitude of that force?



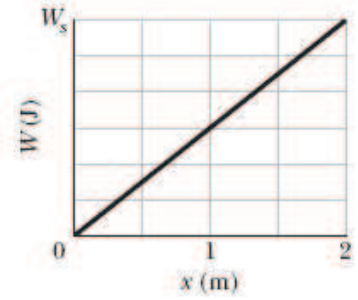
(1) 5 N (2) 10 N (3) 6 N (4) 2 N (5) 7 N

54. A can of bolts and nuts is pushed 2 m along an x axis by a broom along the greasy (frictionless) floor of a car repair shop in a version of shuffleboard. The figure gives the work W done on the can by the constant horizontal force from the broom, versus the can's position x. The scale of the figure's vertical axis is set by $W_s = 12$ J. What is the magnitude of that force?



(1) 6 N (2) 10 N (3) 7 N (4) 2 N (5) 5 N

55. A can of bolts and nuts is pushed 2 m along an x axis by a broom along the greasy (frictionless) floor of a car repair shop in a version of shuffleboard. The figure gives the work W done on the can by the constant horizontal force from the broom, versus the can's position x. The scale of the figure's vertical axis is set by $W_s = 14$ J. What is the magnitude of that force?



(1) 7 N (2) 10 N (3) 6 N (4) 5 N (5) 15 N

56. The escape speed from the surface of a planet is the minimal initial speed a projectile must have to escape the gravitational pull of the planet. For the Earth the escape speed is about 11.2 km/s. What is the escape speed (in km/s) from a planet that has twice the mass of the Earth and one-half the radius of the Earth?

(1) 22.4 (2) 15.8 (3) 11.2 (4) 5.6 (5) 33.6

57. The escape speed from the surface of a planet is the minimal initial speed a projectile must have to escape the gravitational pull of the planet. For the Earth the escape speed is about 11.2 km/s. What is the escape speed (in km/s) from a planet that has one-half the mass of the Earth and twice the radius of the Earth?

(1) 5.6 (2) 15.8 (3) 11.2 (4) 22.4 (5) 33.6

58. The escape speed from the surface of a planet is the minimal initial speed a projectile must have to escape the gravitational pull of the planet. For the Earth the escape speed is about 11.2 km/s. What is the escape speed (in km/s) from a planet that has twice the mass of the Earth and twice the radius of the Earth?

(1) 11.2 (2) 15.8 (3) 5.6 (4) 22.4 (5) 33.6

FOLLOWING GROUPS OF QUESTIONS WILL BE SELECTED AS ONE GROUP FROM EACH TYPE
TYPE 1
Q# S 1
Q# S 2
Q# S 3
TYPE 2
Q# S 4
Q# S 5
Q# S 6
TYPE 3
Q# S 7
Q# S 8
Q# S 9
TYPE 4
Q# S 10
Q# S 11
Q# S 12
TYPE 5
Q# S 13
Q# S 14
Q# S 15
TYPE 6
Q# S 16
Q# S 17
Q# S 18
TYPE 7
Q# S 19
Q# S 20
Q# S 21
TYPE 8
Q# S 22
Q# S 23
Q# S 24
TYPE 9
Q# S 25
Q# S 26
Q# S 27
TYPE 10
Q# S 28
Q# S 29
Q# S 30
TYPE 11
Q# S 31
Q# S 32
Q# S 33
TYPE 12
Q# S 34
Q# S 35
Q# S 36
TYPE 13
Q# S 37
Q# S 38
Q# S 39
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

77777

Q# S 57
Q# S 58