 77777

Instructor(s): *Field/Furic*

PHYSICS DEPARTMENT

PHY 2053 — Final Exam — December 7, 2013

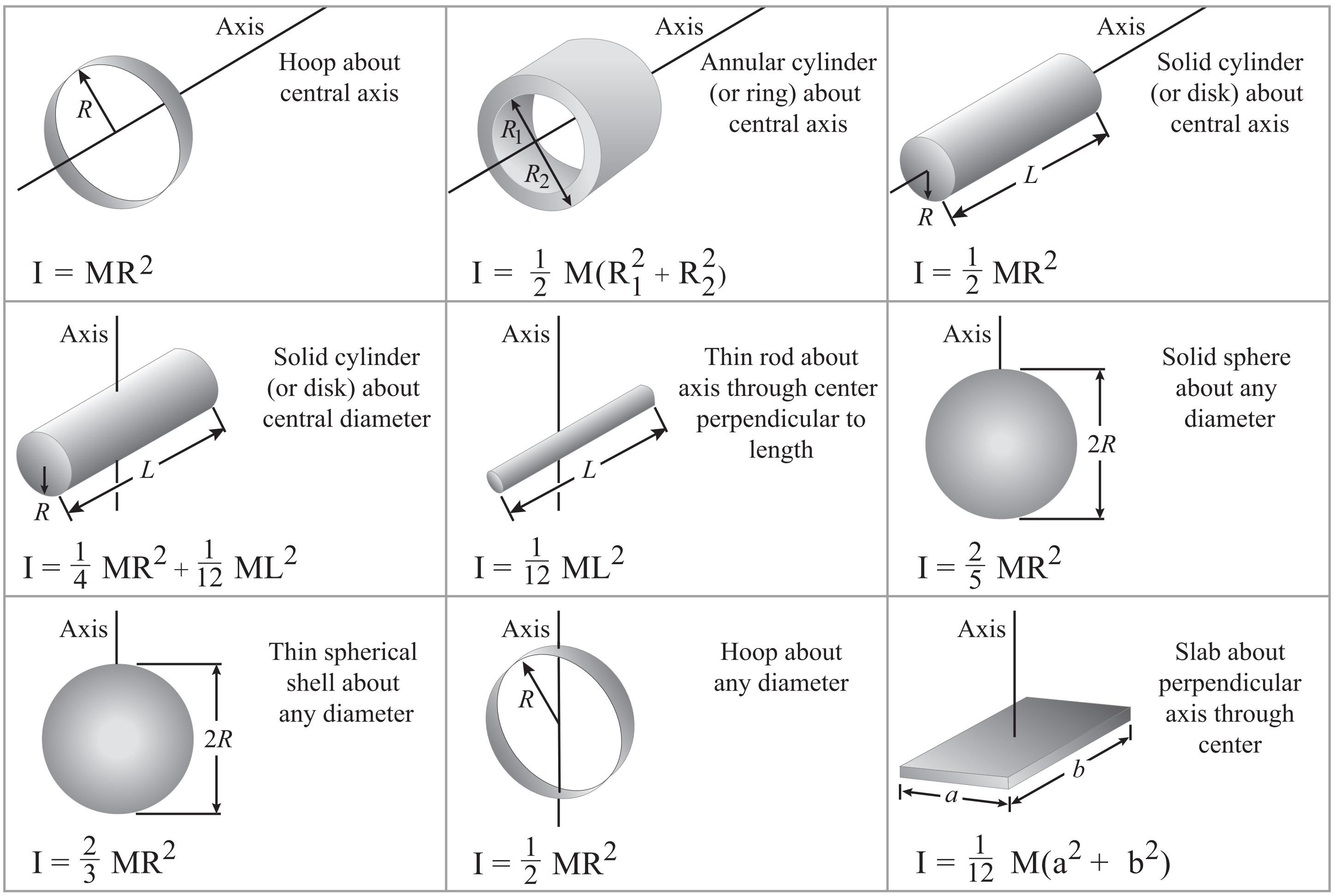
Name (print, last first): ______________________ Signature: ______________________

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

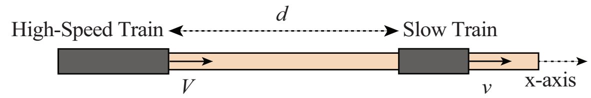
YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

(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 <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 $g = 9.80$ m/s^2

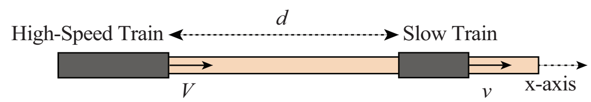


1. At $t = 0$ the engineer of a high-speed train traveling to the right at speed $V = 200$ m/s along the x-axis sees a slow train traveling on the track to the right at a constant speed $v = 50$ m/s a distance $d = 1,000$ meters ahead as shown in the figure. The engineer of the high-speed train immediately applies the brakes. If the high-speed train decelerates at a constant rate (*i.e.,* constant acceleration in the negative x-direction), and the slow train continues at a constant speed v, what is the magnitude of the minimum constant deceleration that the high-speed must have in order to prevent a collision with the slow train?



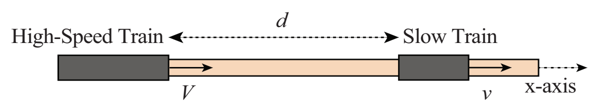
(1) 11.25 m/s^2 (2) 14.45 m/s^2 (3) 18.05 m/s^2 (4) 20.00 m/s^2 (5) 24.20 m/s^2

2. At $t = 0$ the engineer of a high-speed train traveling to the right at speed $V = 220$ m/s along the x-axis sees a slow train traveling on the track to the right at a constant speed $v = 50$ m/s a distance $d = 1,000$ meters ahead as shown in the figure. The engineer of the high-speed train immediately applies the brakes. If the high-speed train decelerates at a constant rate (*i.e.,* constant acceleration in the negative x-direction), and the slow train continues at a constant speed v, what is the magnitude of the minimum constant deceleration that the high-speed must have in order to prevent a collision with the slow train?



(1) 14.45 m/s^2 (2) 11.25 m/s^2 (3) 18.05 m/s^2 (4) 20.00 m/s^2 (5) 24.20 m/s^2

3. At $t = 0$ the engineer of a high-speed train traveling to the right at speed $V = 240$ m/s along the x-axis sees a slow train traveling on the track to the right at a constant speed $v = 50$ m/s a distance $d = 1,000$ meters ahead as shown in the figure. The engineer of the high-speed train immediately applies the brakes. If the high-speed train decelerates at a constant rate (*i.e.,* constant acceleration in the negative x-direction), and the slow train continues at a constant speed v, what is the magnitude of the minimum constant deceleration that the high-speed must have in order to prevent a collision with the slow train?



(1) 18.05 m/s^2 (2) 11.25 m/s^2 (3) 14.45 m/s^2 (4) 20.00 m/s^2 (5) 24.20 m/s^2

4. Near the surface of the Earth a man whose weight at rest is 200 N stands on a scale in an elevator that starts from rest and accelerates upward with a constant acceleration. If after the elevator has traveled a distance of 10 m its speed is 4 m/s, what is his weight (in N) on the scale in the elevator during his ride?

(1) 216.3 (2) 236.7 (3) 265.3 (4) 183.7 (5) 163.3

5. Near the surface of the Earth a man whose weight at rest is 200 N stands on a scale in an elevator that starts from rest and accelerates upward with a constant acceleration. If after the elevator has traveled a distance of 10 m its speed is 6 m/s, what is his weight (in N) on the scale in the elevator during his ride?

(1) 236.7 (2) 216.3 (3) 265.3 (4) 183.7 (5) 163.3

6. Near the surface of the Earth a man whose weight at rest is 200 N stands on a scale in an elevator that starts from rest and accelerates upward with a constant acceleration. If after the elevator has traveled a distance of 10 m its speed is 8 m/s, what is his weight (in N) on the scale in the elevator during his ride?

(1) 265.3 (2) 216.3 (3) 236.7 (4) 183.7 (5) 134.7

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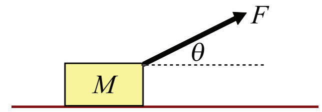
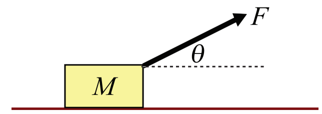
7. Near the surface of the Earth, a block of mass $M = 2$ kg is pulled along a horizontal surface at a constant speed by a constant force F that is at an angle $\theta = 45°$ with the horizontal as shown in the figure. If the kinetic coefficient of friction between the block and the horizontal surface is $\mu_k = 0.2$, what is the magnitude of the normal force that the surface exerts on the block (in N)?



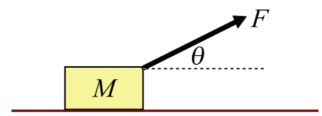
(1) 16.3 (2) 14.0 (3) 12.3 (4) 19.6 (5) 10.6

8. Near the surface of the Earth, a block of mass $M = 2$ kg is pulled along a horizontal surface at a constant speed by a constant force F that is at an angle $\theta = 45°$ with the horizontal as shown in the figure. If the kinetic coefficient of friction between the block and the horizontal surface is $\mu_k = 0.4$, what is the magnitude of the normal force that the surface exerts on the block (in N)?



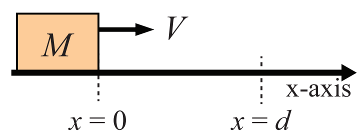
(1) 14.0 (2) 16.3 (3) 12.3 (4) 19.6 (5) 10.6

9. Near the surface of the Earth, a block of mass $M = 2$ kg is pulled along a horizontal surface at a constant speed by a constant force F that is at an angle $\theta = 45°$ with the horizontal as shown in the figure. If the kinetic coefficient of friction between the block and the horizontal surface is $\mu_k = 0.6$, what is the magnitude of the normal force that the surface exerts on the block (in N)?



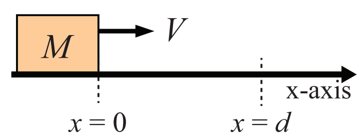
(1) 12.3 (2) 16.3 (3) 14.0 (4) 19.6 (5) 10.6

10. Near the surface of the Earth a block of mass M is sliding along a horizontal surface as shown in the figure. The kinetic coefficient of friction between the block and the horizontal surface is $\mu_k = 0.2$. If the block is traveling at a speed of 12 m/s when it is at the point $x = 0$, at what point $x = d$ (in m) does the block come to rest?



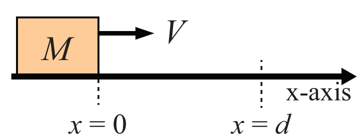
(1) 36.7 (2) 24.5 (3) 18.4 (4) 39.2 (5) 14.5

11. Near the surface of the Earth a block of mass M is sliding along a horizontal surface as shown in the figure. The kinetic coefficient of friction between the block and the horizontal surface is $\mu_k = 0.3$. If the block is traveling at a speed of 12 m/s when it is at the point $x = 0$, at what point $x = d$ (in m) does the block come to rest?



(1) 24.5 (2) 36.7 (3) 18.4 (4) 39.2 (5) 14.5

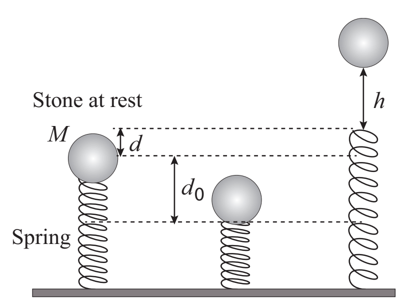
12. Near the surface of the Earth a block of mass M is sliding along a horizontal surface as shown in the figure. The kinetic coefficient of friction between the block and the horizontal surface is $\mu_k = 0.4$. If the block is traveling at a speed of 12 m/s when it is at the point $x = 0$, at what point $x = d$ (in m) does the block come to rest?



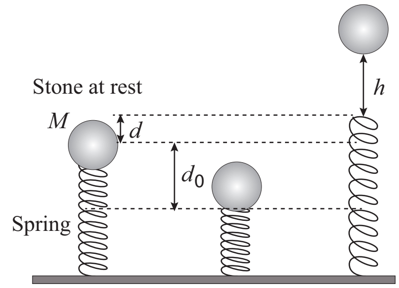
(1) 18.4 (2) 36.7 (3) 24.5 (4) 39.2 (5) 14.5

13. When a stone of mass M is placed at rest on an elastic spring, the spring is compressed a distance d by the weight of the stone as shown in the figure. If the stone is now pushed down compressing the spring an additional distance $d_0 = 2d$ and released from rest, to what maximum height h above the uncompressed spring will the stone travel?

(1) $3d/2$
(2) $4d$
(3) $15d/2$
(4) $2d$
(5) d

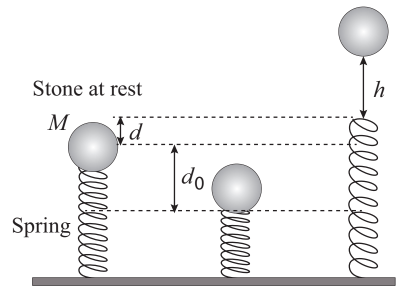


14. When a stone of mass M is placed at rest on an elastic spring, the spring is compressed a distance d by the weight of the stone as shown in the figure. If the stone is now pushed down compressing the spring an additional distance $d_0 = 3d$ and released from rest, to what maximum height h above the uncompressed spring will the stone travel?



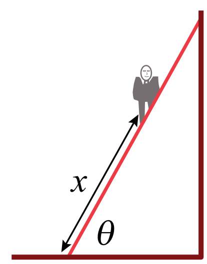
(1) $4d$
(2) $3d/2$
(3) $15d/2$
(4) $2d$
(5) d

15. When a stone of mass M is placed at rest on an elastic spring, the spring is compressed a distance d by the weight of the stone as shown in the figure. If the stone is now pushed down compressing the spring an additional distance $d_0 = 4d$ and released from rest, to what maximum height h above the uncompressed spring will the stone travel?



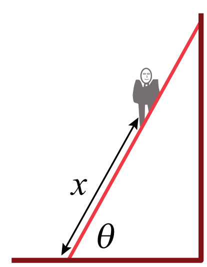
(1) $15d/2$
(2) $3d/2$
(3) $4d$
(4) $2d$
(5) d

16. A 200-N man climbs up a 100-N uniform ladder of length L that is leaning against a frictionless wall as shown in the figure. If the static coefficient of friction between the ladder and the floor is $\mu_s = 0.4$, and if he can climb up the ladder a distance $x = 3L/4$ before the ladder begins to slip, what is the angle θ?



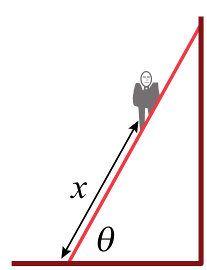
(1) 59.0°
(2) 53.1°
(3) 48.0°
(4) 65.2°
(5) 42.1°

17. A 200-N man climbs up a 100-N uniform ladder of length L that is leaning against a frictionless wall as shown in the figure. If the static coefficient of friction between the ladder and the floor is $\mu_s = 0.5$, and if he can climb up the ladder a distance $x = 3L/4$ before the ladder begins to slip, what is the angle θ?



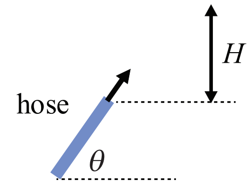
(1) 53.1°
(2) 59.0°
(3) 48.0°
(4) 65.2°
(5) 42.1°

18. A 200-N man climbs up a 100-N uniform ladder of length L that is leaning against a frictionless wall as shown in the figure. If the static coefficient of friction between the ladder and the floor is $\mu_s = 0.6$, and if he can climb up the ladder a distance $x = 3L/4$ before the ladder begins to slip, what is the angle θ?



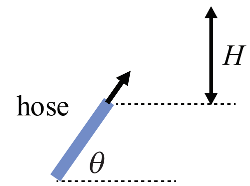
(1) 48.0°
(2) 59.0°
(3) 53.1°
(4) 65.2°
(5) 42.1°

19. Near the surface of the Earth, a garden hose of inner radius 3 cm carries water at 2.0 m/s. The nozzle at the end has a radius of 1.5 cm and is held at an angle $\theta = 45°$ as shown in the figure. How high (in m) will the water rise above the nozzle, (*i.e.*, what is H)?



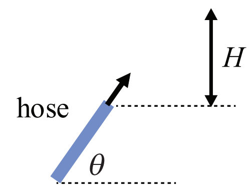
(1) 1.63 (2) 3.67 (3) 6.53 (4) 3.27 (5) 7.35

20. Near the surface of the Earth, a garden hose of inner radius 3 cm carries water at 3.0 m/s. The nozzle at the end has a radius of 1.5 cm and is held at an angle $\theta = 45°$ as shown in the figure. How high (in m) will the water rise above the nozzle, (*i.e.*, what is H)?



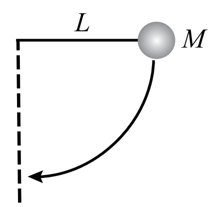
(1) 3.67 (2) 1.63 (3) 6.53 (4) 3.27 (5) 7.35

21. Near the surface of the Earth, a garden hose of inner radius 3 cm carries water at 4.0 m/s. The nozzle at the end has a radius of 1.5 cm and is held at an angle $\theta = 45°$ as shown in the figure. How high (in m) will the water rise above the nozzle, (*i.e.*, what is H)?



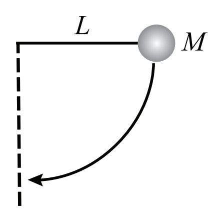
(1) 6.53 (2) 1.63 (3) 3.67 (4) 3.27 (5) 7.35

22. Near the surface of the Earth, a wrecking ball of mass M is connected to a steel cable that has a diameter of 2.0 cm and an unstretched length of $L = 40$ m. The other end of the cable is fixed in position and the ball is initially held at rest horizontally, as shown in the figure. When the ball is released from rest it swings down. The Young's modulus of steel is 2.0×10^{11}Pa. Ignoring the weight of the cable itself, if when the ball-cable system swings through vertical (*i.e.*, ball at its lowest point) the cable stretches 2 cm, what is the mass M of the wrecking ball (in kg)?



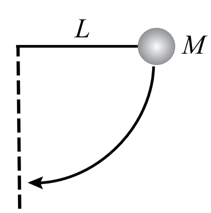
(1) 1068.6 (2) 1335.7 (3) 1602.9 (4) 3205.7 (5) 4007.1

23. Near the surface of the Earth, a wrecking ball of mass M is connected to a steel cable that has a diameter of 2.0 cm and an unstretched length of $L = 40$ m. The other end of the cable is fixed in position and the ball is initially held at rest horizontally, as shown in the figure. When the ball is released from rest it swings down. The Young's modulus of steel is 2.0×10^{11}Pa. Ignoring the weight of the cable itself, if when the ball-cable system swings through vertical (*i.e.*, ball at its lowest point) the cable stretches 2.5 cm, what is the mass M of the wrecking ball (in kg)?



(1) 1335.7 (2) 1068.6 (3) 1602.9 (4) 3205.7 (5) 4007.1

24. Near the surface of the Earth, a wrecking ball of mass M is connected to a steel cable that has a diameter of 2.0 cm and an unstretched length of $L = 40$ m. The other end of the cable is fixed in position and the ball is initially held at rest horizontally, as shown in the figure. When the ball is released from rest it swings down. The Young's modulus of steel is 2.0×10^{11}Pa. Ignoring the weight of the cable itself, if when the ball-cable system swings through vertical (*i.e.*, ball at its lowest point) the cable stretches 3 cm, what is the mass M of the wrecking ball (in kg)?

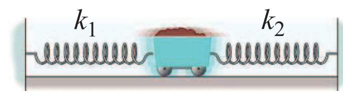


(1) 1602.9 (2) 1068.6 (3) 1335.7 (4) 3205.7 (5) 4007.1

25. As shown in the figure, a cart of mass M on a frictionless horizontal track is tied between two ideal springs with spring constants, k_1 and k_2, respectively. If $k_1 = k_2 = 10$ N/m, the cart oscillates with angular frequency ω. If the spring constants are changed to $k_1 = 50$ N/m and $k_2 = 30$ N/m, and the mass of the cart is increased to $4M$, what is the new angular frequency of the oscillation?

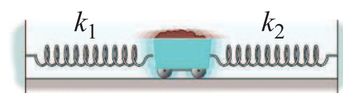
(1) ω (2) $3\omega/2$ (3) 2ω (4) 4ω (5) $\omega/2$

26. As shown in the figure, a cart of mass M on a frictionless horizontal track is tied between two ideal springs with spring constants, k_1 and k_2, respectively. If $k_1 = k_2 = 10$ N/m, the cart oscillates with angular frequency ω. If the spring constants are changed to $k_1 = 100$ N/m and $k_2 = 80$ N/m, and the mass of the cart is increased to $4M$, what is the new angular frequency of the oscillation?



(1) $3\omega/2$ (2) ω (3) 2ω (4) 4ω (5) $\omega/2$

27. As shown in the figure, a cart of mass M on a frictionless horizontal track is tied between two ideal springs with spring constants, k_1 and k_2, respectively. If $k_1 = k_2 = 10$ N/m, the cart oscillates with angular frequency ω. If the spring constants are changed to $k_1 = 200$ N/m and $k_2 = 120$ N/m, and the mass of the cart is increased to $4M$, what is the new angular frequency of the oscillation?



(1) 2ω (2) ω (3) $3\omega/2$ (4) 4ω (5) $\omega/2$

28. An ideal spring-and-mass system is undergoing simple harmonic motion (SHM). If the speed of the block is 1.0 m/s when the displacement from equilibrium is 4.0 m, and the speed of the block is 4.0 m/s when the displacement from equilibrium is 1.0 m, what is the amplitude of the oscillations (in m)?

(1) 4.12 (2) 4.58 (3) 5.94 (4) 6.25 (5) 7.05

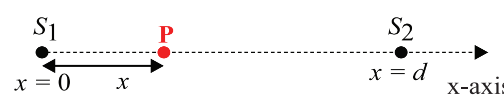
29. An ideal spring-and-mass system is undergoing simple harmonic motion (SHM). If the speed of the block is 2.0 m/s when the displacement from equilibrium is 4.0 m, and the speed of the block is 4.0 m/s when the displacement from equilibrium is 1.0 m, what is the amplitude of the oscillations (in m)?

(1) 4.58 (2) 4.12 (3) 5.94 (4) 6.25 (5) 7.05

30. An ideal spring-and-mass system is undergoing simple harmonic motion (SHM). If the speed of the block is 3.0 m/s when the displacement from equilibrium is 4.0 m, and the speed of the block is 4.0 m/s when the displacement from equilibrium is 1.0 m, what is the amplitude of the oscillations (in m)?

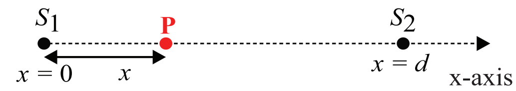
(1) 5.94 (2) 4.12 (3) 4.58 (4) 6.25 (5) 7.05

31. The figure shows two isotropic point sources of sound on the x-axis, source S_1 at $x = 0$ and source S_2 at $x = d$. The sources emit sound at the same wavelength λ and the same amplitude A, and they emit in phase. A point P is shown on the x-axis with $0 < x < d$. Assume that as the sound waves travel to the point P, the decrease in their amplitude is negligible. If $\lambda = d$, at what points P along the x-axis does maximally destructive interference occur?



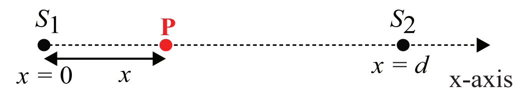
(1) $x = 0.25d$ and $x = 0.75d$
(2) $x = 0.20d$ and $x = 0.80d$
(3) $x = 0.15d$ and $x = 0.85d$
(4) $x = 0.10d$ and $x = 0.90d$
(5) Only at $x = 0.50d$

32. The figure shows two isotropic point sources of sound on the x-axis, source S_1 at $x = 0$ and source S_2 at $x = d$. The sources emit sound at the same wavelength λ and the same amplitude A, and they emit in phase. A point P is shown on the x-axis with $0 < x < d$. Assume that as the sound waves travel to the point P, the decrease in their amplitude is negligible. If $\lambda = 1.2d$, at what points P along the x-axis does maximally destructive interference occur?



(1) $x = 0.20d$ and $x = 0.80d$
(2) $x = 0.25d$ and $x = 0.75d$
(3) $x = 0.15d$ and $x = 0.85d$
(4) $x = 0.10d$ and $x = 0.90d$
(5) Only at $x = 0.50d$

33. The figure shows two isotropic point sources of sound on the x-axis, source S_1 at $x = 0$ and source S_2 at $x = d$. The sources emit sound at the same wavelength λ and the same amplitude A, and they emit in phase. A point P is shown on the x-axis with $0 < x < d$. Assume that as the sound waves travel to the point P, the decrease in their amplitude is negligible. If $\lambda = 1.4d$, at what points P along the x-axis does maximally destructive interference occur?



(1) $x = 0.15d$ and $x = 0.85d$
(2) $x = 0.25d$ and $x = 0.75d$
(3) $x = 0.20d$ and $x = 0.80d$
(4) $x = 0.10d$ and $x = 0.90d$
(5) Only at $x = 0.50d$

34. Stan and Ollie are standing next to a train track. Stan puts his ear to the steel track to hear the train coming. When the train is 745 m away, he hears the sound of the train whistle through the track 2.0 s before Ollie hears it through the air. If the speed of sound in steel is 5790 m/s, what is the temperature of the air (in °C)?

(1) 32.2 (2) 28.4 (3) 20.8 (4) 18.2 (5) 15.5

35. Stan and Ollie are standing next to a train track. Stan puts his ear to the steel track to hear the train coming. When the train is 740 m away, he hears the sound of the train whistle through the track 2.0 s before Ollie hears it through the air. If the speed of sound in steel is 5790 m/s, what is the temperature of the air (in °C)?

(1) 28.4 (2) 32.2 (3) 20.8 (4) 18.2 (5) 15.5

36. Stan and Ollie are standing next to a train track. Stan puts his ear to the steel track to hear the train coming. When the train is 730 m away, he hears the sound of the train whistle through the track 2.0 s before Ollie hears it through the air. If the speed of sound in steel is 5790 m/s, what is the temperature of the air (in °C)?

(1) 20.8 (2) 32.2 (3) 28.4 (4) 18.2 (5) 15.5

37. As a race car passes the spectators at rest on the side of the track, the frequency of the sound of the engine after passing is 0.6 times what it was before. How fast is the race car moving (in m/s)? (Take the speed of sound in the air to be 343 m/s.)

(1) 85.8 (2) 60.5 (3) 38.1 (4) 94.6 (5) 29.6

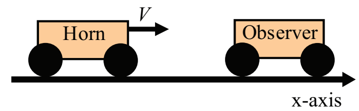
38. As a race car passes the spectators at rest on the side of the track, the frequency of the sound of the engine after passing is 0.7 times what it was before. How fast is the race car moving (in m/s)? (Take the speed of sound in the air to be 343 m/s.)

(1) 60.5 (2) 85.8 (3) 38.1 (4) 94.6 (5) 29.6

39. As a race car passes the spectators at rest on the side of the track, the frequency of the sound of the engine after passing is 0.8 times what it was before. How fast is the race car moving (in m/s)? (Take the speed of sound in the air to be 343 m/s.)

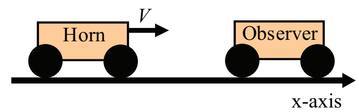
(1) 38.1 (2) 85.8 (3) 60.5 (4) 94.6 (5) 29.6

40. A large horn with fundamental frequency $f_0 = 500$ Hz is mounted on a car that is moving to the right at speed $V = 50$ m/s toward an observer as shown in the figure. If the speed of sound in the air is 343 m/s and if the observer hears a frequency of 450 Hz, what is the x-component of the velocity of the observer (in m/s)?



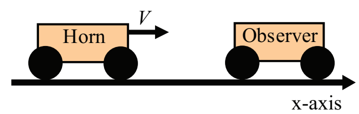
(1) 79.3 (2) 20.7 (3) −8.6 (4) 65.2 (5) −79.3

41. A large horn with fundamental frequency $f_0 = 500$ Hz is mounted on a car that is moving to the right at speed $V = 50$ m/s toward an observer as shown in the figure. If the speed of sound in the air is 343 m/s and if the observer hears a frequency of 550 Hz, what is the x-component of the velocity of the observer (in m/s)?



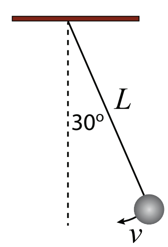
(1) 20.7 (2) 79.3 (3) −8.6 (4) 65.2 (5) −20.7

42. A large horn with fundamental frequency $f_0 = 500$ Hz is mounted on a car that is moving to the right at speed $V = 50$ m/s toward an observer as shown in the figure. If the speed of sound in the air is 343 m/s and if the observer hears a frequency of 600 Hz, what is the x-component of the velocity of the observer (in m/s)?



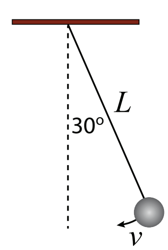
(1) −8.6 (2) 79.3 (3) 20.7 (4) 8.6 (5) −79.3

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 maximum angle the string makes with the vertical during its subsequent swing is 40°, what is the initial tangential speed, v, of the suspended mass when at the release point?



(1) 1.98 m/s (2) 2.96 m/s (3) 3.79 m/s (4) 0.47 m/s (5) 4.95 m/s

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 maximum angle the string makes with the vertical during its subsequent swing is 50°, what is the initial tangential speed, v, of the suspended mass when at the release point?



(1) 2.96 m/s (2) 1.98 m/s (3) 3.79 m/s (4) 0.47 m/s (5) 4.95 m/s

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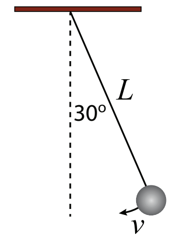
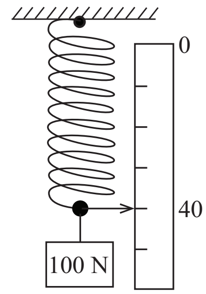
45. A ball of mass M is connected to a thin string with negligible mass and length $L = 2.0$ m. It is released by a push when the string is at an angle of 30° from the vertical as shown in the figure. If the maximum angle the string makes with the vertical during its subsequent swing is 60°, what is the initial tangential speed, v, of the suspended mass when at the release point?



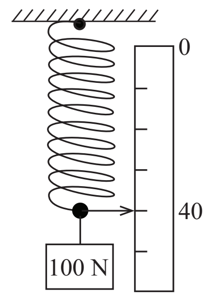
(1) 3.79 m/s (2) 1.98 m/s (3) 2.96 m/s (4) 0.47 m/s (5) 4.95 m/s

46. An ideal spring, with a pointer attached to its end, hangs next to a linear scale. With a 100-N weight attached, the pointer indicates "40" on the scale as shown. Using a 200-N weight instead results in "60" on the scale. Using an unknown weight W instead results in "35" on the scale. The weight of W is



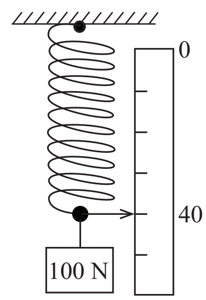
(1) 75 N
(2) 125 N
(3) 175 N
(4) 50 N
(5) 25 N

47. An ideal spring, with a pointer attached to its end, hangs next to a linear scale. With a 100-N weight attached, the pointer indicates "40" on the scale as shown. Using a 200-N weight instead results in "60" on the scale. Using an unknown weight W instead results in "45" on the scale. The weight of W is



(1) 125 N
(2) 75 N
(3) 175 N
(4) 50 N
(5) 25 N

48. An ideal spring, with a pointer attached to its end, hangs next to a linear scale. With a 100-N weight attached, the pointer indicates "40" on the scale as shown. Using a 200-N weight instead results in "60" on the scale. Using an unknown weight W instead results in "55" on the scale. The weight of W is



(1) 175 N
(2) 75 N
(3) 125 N
(4) 50 N
(5) 25 N

49. A disk rotates about its central axis starting from rest at $t = 0$ and accelerates with constant angular acceleration. At one time it is rotating at 4 rev/s; 60 revolutions later, its angular speed is 16 rev/s. Starting at $t = 0$, how many revolutions will the disk complete in 8 seconds?

(1) 64 (2) 81 (3) 100 (4) 32 (5) 90

50. A disk rotates about its central axis starting from rest at $t = 0$ and accelerates with constant angular acceleration. At one time it is rotating at 4 rev/s; 60 revolutions later, its angular speed is 16 rev/s. Starting at $t = 0$, how many revolutions will the disk complete in 9 seconds?

(1) 81 (2) 64 (3) 100 (4) 32 (5) 90

51. A disk rotates about its central axis starting from rest at $t = 0$ and accelerates with constant angular acceleration. At one time it is rotating at 4 rev/s; 60 revolutions later, its angular speed is 16 rev/s. Starting at $t = 0$, how many revolutions will the disk complete in 10 seconds?

(1) 100 (2) 64 (3) 81 (4) 32 (5) 90

52. An object hangs from a spring balance. When submerged in water (density ρ_{water}) the object weighs 4 N and when submerged in a liquid with a specific gravity of 0.2 (*i.e.,* $\rho/\rho_{\text{water}} = 0.2$) the object weighs 8 N. What is the weight of the object in air? (neglect the density of air)

(1) 9 N (2) 12 N (3) 14 N (4) 2 N (5) 16 N

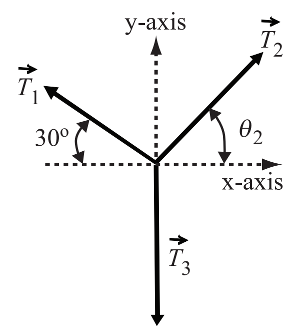
53. An object hangs from a spring balance. When submerged in water (density ρ_{water}) the object weighs 4 N and when submerged in a liquid with a specific gravity of 0.5 (*i.e.,* $\rho/\rho_{\text{water}} = 0.5$) the object weighs 8 N. What is the weight of the object in air? (neglect the density of air)

(1) 12 N (2) 9 N (3) 14 N (4) 2 N (5) 16 N

54. An object hangs from a spring balance. When submerged in water (density ρ_{water}) the object weighs 4 N and when submerged in a liquid with a specific gravity of 0.6 (*i.e.,* $\rho/\rho_{\text{water}} = 0.6$) the object weighs 8 N. What is the weight of the object in air? (neglect the density of air)

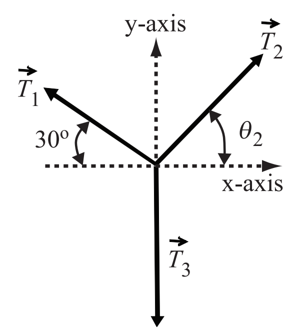
(1) 14 N (2) 9 N (3) 12 N (4) 2 N (5) 16 N

55. The system shown in the figure is in equilibrium (*i.e.,* the sum of all forces acting at the origin is zero). If the magnitude of the tension T_3 is one-half the magnitude of the tension T_1, what is the angle θ_2?



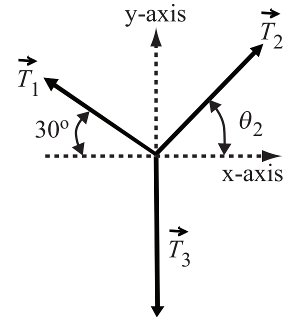
(1) zero
(2) 30°
(3) 60°
(4) 45°
(5) 10°

56. The system shown in the figure is in equilibrium (*i.e.,* the sum of all forces acting at the origin is zero). If the magnitude of the tension T_3 is equal to the magnitude of the tension T_1, what is the angle θ_2?



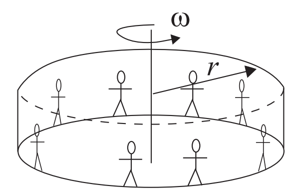
(1) 30°
(2) zero
(3) 60°
(4) 45°
(5) 10°

57. The system shown in the figure is in equilibrium (*i.e.,* the sum of all forces acting at the origin is zero). If the magnitude of the tension T_3 is twice the magnitude of the tension T_1, what is the angle θ_2?



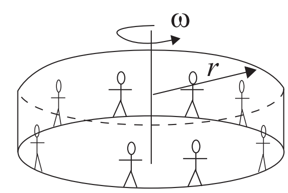
(1) 60°
(2) zero
(3) 30°
(4) 45°
(5) 10°

58. Near ther surface of the Earth, a carnival ride consists of the riders standing against the inside wall of a cylindrical room having radius $R = 5.0$ m. The room spins about the vertical cylinder axis with angular velocity ω. Once it is up to speed, the floor of the room falls away. If the coefficient of static friction between the riders and the wall is $\mu_s = 0.2$, what is the minimum angular velocity ω (in rad/s) that will keep them from dropping with the floor?



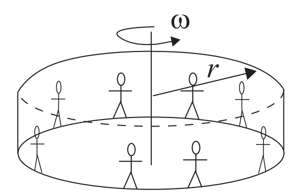
(1) 3.13 (2) 2.56 (3) 2.21 (4) 4.19 (5) 1.73

59. Near ther surface of the Earth, a carnival ride consists of the riders standing against the inside wall of a cylindrical room having radius $R = 5.0$ m. The room spins about the vertical cylinder axis with angular velocity ω. Once it is up to speed, the floor of the room falls away. If the coefficient of static friction between the riders and the wall is $\mu_s = 0.3$, what is the minimum angular velocity ω (in rad/s) that will keep them from dropping with the floor?



(1) 2.56 (2) 3.13 (3) 2.21 (4) 4.19 (5) 1.73

60. Near ther surface of the Earth, a carnival ride consists of the riders standing against the inside wall of a cylindrical room having radius $R = 5.0$ m. The room spins about the vertical cylinder axis with angular velocity ω. Once it is up to speed, the floor of the room falls away. If the coefficient of static friction between the riders and the wall is $\mu_s = 0.4$, what is the minimum angular velocity ω (in rad/s) that will keep them from dropping with the floor?



(1) 2.21 (2) 3.13 (3) 2.56 (4) 4.19 (5) 1.73

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 40
Q# S 41
Q# S 42
TYPE 15
Q# S 43
Q# S 44
Q# S 45
TYPE 16
Q# S 46
Q# S 47
Q# S 48
TYPE 17
Q# S 49
Q# S 50
Q# S 51
TYPE 18
Q# S 52
Q# S 53
Q# S 54
TYPE 19
Q# S 55
Q# S 56
Q# S 57
TYPE 20
Q# S 58
Q# S 59
Q# S 60