Instructor(s): *Field/Rinzler*

PHYSICS DEPARTMENT

PHY 2053 Exam 2 April 1, 2014

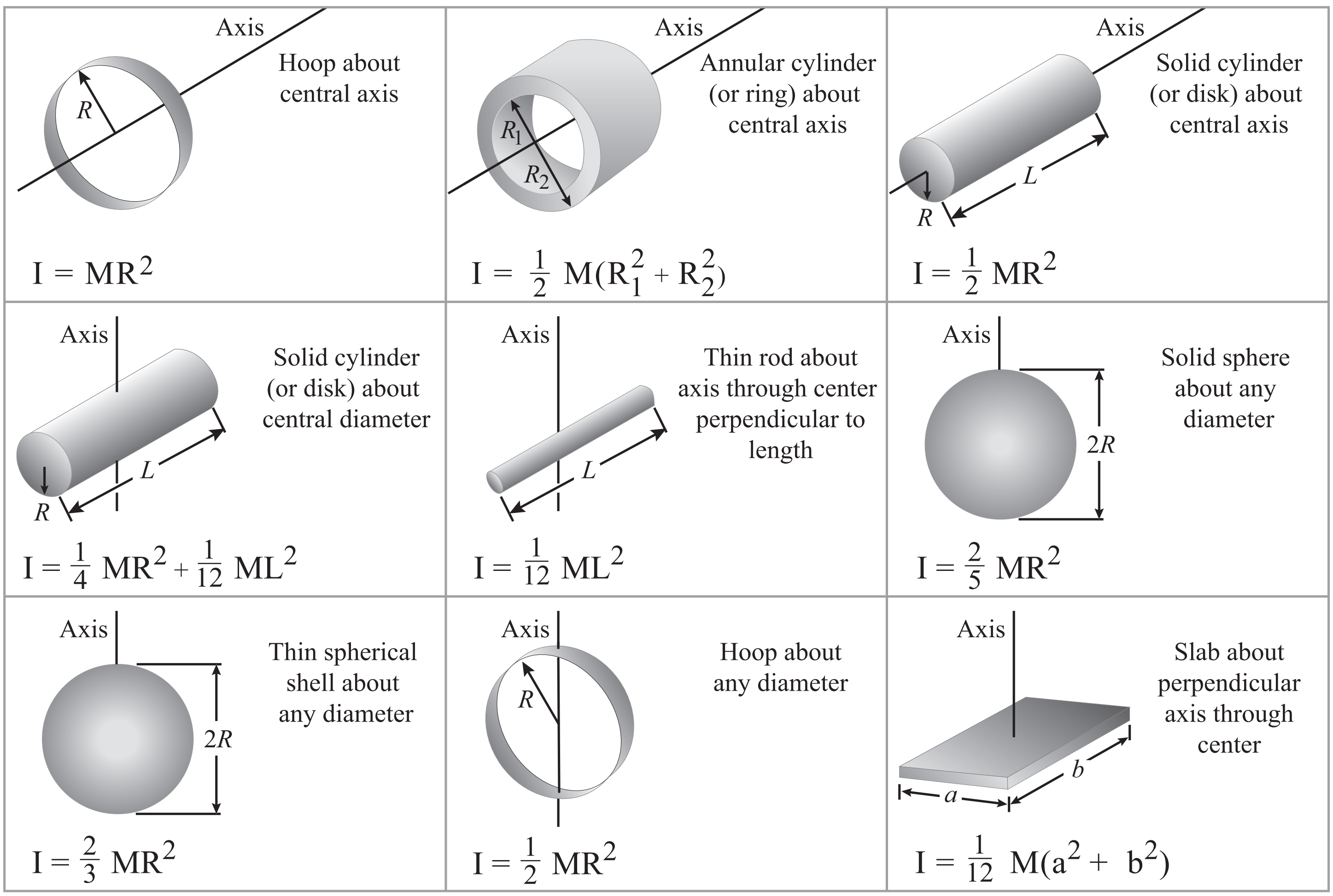
Name (print, last first): ______________________ Signature: ______________________

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.

Where needed use $g = 9.80\ \mathrm{m/s^2}$



1. A stone is dropped from rest 50 m above the surface of the Earth. If the magnitude of the momentum of the stone is 39.2 kg·m/s two seconds after the stone is released, what is the mass of the stone (in kg)?

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

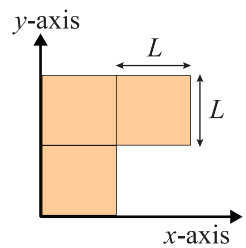
2. A stone is dropped from rest 50 m above the surface of the Earth. If the magnitude of the momentum of the stone is 58.8 kg·m/s two seconds after the stone is released, what is the mass of the stone (in kg)?

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

3. A stone is dropped from rest 50 m above the surface of the Earth. If the magnitude of the momentum of the stone is 78.4 kg·m/s two seconds after the stone is released, what is the mass of the stone (in kg)?

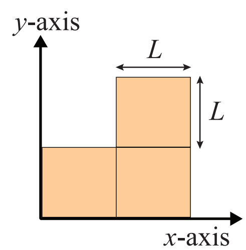
   (1) 4 (2) 2 (3) 3 (4) 1 (5) 5

4. Three uniform square slabs are arranged in the xy-plane as shown in the figure. Each of the three squares have mass M and sides of length L. If $L = 6$ m, what are the x and y components of the center-of-mass of the three slab system?



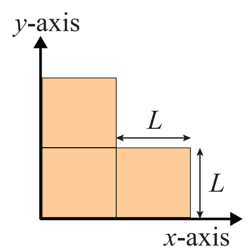
   (1) $x_{cm} = 5$ m, $y_{cm} = 7$ m
   (2) $x_{cm} = 7$ m, $y_{cm} = 5$ m
   (3) $x_{cm} = 5$ m, $y_{cm} = 5$ m
   (4) $x_{cm} = 7$ m, $y_{cm} = 7$ m
   (5) $x_{cm} = 4$ m, $y_{cm} = 7$ m

5. Three uniform square slabs are arranged in the xy-plane as shown in the figure. Each of the three squares have mass M and sides of length L. If $L = 6$ m, what are the x and y components of the center-of-mass of the three slab system?



   (1) $x_{cm} = 7$ m, $y_{cm} = 5$ m
   (2) $x_{cm} = 5$ m, $y_{cm} = 7$ m
   (3) $x_{cm} = 5$ m, $y_{cm} = 5$ m
   (4) $x_{cm} = 7$ m, $y_{cm} = 7$ m
   (5) $x_{cm} = 4$ m, $y_{cm} = 7$ m

6. Three uniform square slabs are arranged in the xy-plane as shown in the figure. Each of the three squares have mass M and sides of length L. If $L = 6$ m, what are the x and y components of the center-of-mass of the three slab system?



   (1) $x_{cm} = 5$ m, $y_{cm} = 5$ m
   (2) $x_{cm} = 5$ m, $y_{cm} = 7$ m
   (3) $x_{cm} = 7$ m, $y_{cm} = 5$ m
   (4) $x_{cm} = 7$ m, $y_{cm} = 7$ m
   (5) $x_{cm} = 4$ m, $y_{cm} = 7$ m

7. At $t = 0$ a 2.0-kg ball is dropped from rest 50 m above surface of the Earth and also at $t = 0$ a second ball, with a mass of 1.0 kg, is thrown straight upward from Earth's surface with an initial speed v_0. If $v_0 = 14.7$ m/s, at what time t (in s) is the velocity of the center-of-mass of the two-ball system equal to zero?

   (1) 0.5 (2) 1.0 (3) 1.5 (4) 2.0 (5) never

8. At $t = 0$ a 2.0-kg ball is dropped from rest 50 m above surface of the Earth and also at $t = 0$ a second ball, with a mass of 1.0 kg, is thrown straight upward from Earth's surface with an initial speed v_0. If $v_0 = 29.4$ m/s, at what time t (in s) is the velocity of the center-of-mass of the two-ball system equal to zero?

(1) 1.0 (2) 0.5 (3) 1.5 (4) 2.0 (5) never

9. At $t = 0$ a 2.0-kg ball is dropped from rest 50 m above surface of the Earth and also at $t = 0$ a second ball, with a mass of 1.0 kg, is thrown straight upward from Earth's surface with an initial speed v_0. If $v_0 = 44.1$ m/s, at what time t (in s) is the velocity of the center-of-mass of the two-ball system equal to zero?

(1) 1.5 (2) 0.5 (3) 1.0 (4) 2.0 (5) never

10. A 0.5-kg rubber ball is dropped from rest a height $H = 19.6$ m above the surface of the Earth. It strikes the sidewalk below and rebounds up to a maximum height of 4.9 m. If the ball was in contact with the sidewalk for 0.2 seconds, what is the magnitude of the average force that the sidewalk exerts on the ball during the collision (in N)?

(1) 73.5 (2) 58.8 (3) 49.0 (4) 38.5 (5) 82.2

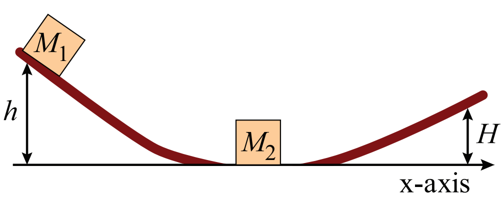
11. A 0.5-kg rubber ball is dropped from rest a height $H = 19.6$ m above the surface of the Earth. It strikes the sidewalk below and rebounds up to a maximum height of 4.9 m. If the ball was in contact with the sidewalk for 0.25 seconds, what is the magnitude of the average force that the sidewalk exerts on the ball during the collision (in N)?

(1) 58.8 (2) 73.5 (3) 49.0 (4) 38.5 (5) 82.2

12. A 0.5-kg rubber ball is dropped from rest a height $H = 19.6$ m above the surface of the Earth. It strikes the sidewalk below and rebounds up to a maximum height of 4.9 m. If the ball was in contact with the sidewalk for 0.3 seconds, what is the magnitude of the average force that the sidewalk exerts on the ball during the collision (in N)?

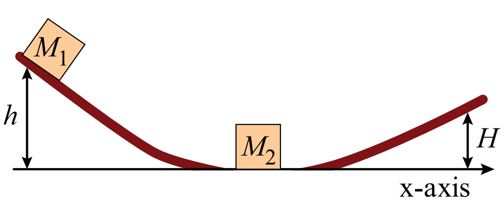
(1) 49.0 (2) 73.5 (3) 58.8 (4) 38.5 (5) 82.2

13. A block of mass M_1 starts from rest at a height $h = 9$ m above the level surface and slides down a smooth ramp as shown in the figure. The block slides down the ramp, across the level surface, and collides with a block of mass M_2 which is at rest. The two blocks stick together and travel up a smooth ramp. If the maximum height that the combined 2-block system reaches is $H = 4$ m and all the surfaces are smooth and frictionless, what is the mass M_2?



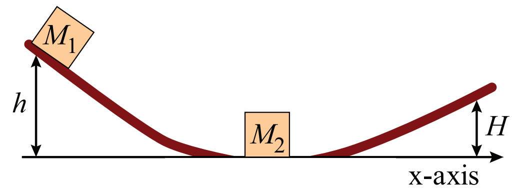
(1) $\frac{1}{2}M_1$ (2) $\frac{1}{3}M_1$ (3) $\frac{2}{3}M_1$ (4) M_1 (5) $2M_1$

14. A block of mass M_1 starts from rest at a height $h = 16$ m above the level surface and slides down a smooth ramp as shown in the figure. The block slides down the ramp, across the level surface, and collides with a block of mass M_2 which is at rest. The two blocks stick together and travel up a smooth ramp. If the maximum height that the combined 2-block system reaches is $H = 9$ m and all the surfaces are smooth and frictionless, what is the mass M_2?



(1) $\frac{1}{3}M_1$ (2) $\frac{1}{2}M_1$ (3) $\frac{2}{3}M_1$ (4) M_1 (5) $2M_1$

15. A block of mass M_1 starts from rest at a height $h = 25$ m above the level surface and slides down a smooth ramp as shown in the figure. The block slides down the ramp, across the level surface, and collides with a block of mass M_2 which is at rest. The two blocks stick together and travel up a smooth ramp. If the maximum height that the combined 2-block system reaches is $H = 9$ m and all the surfaces are smooth and frictionless, what is the mass M_2?



(1) $\frac{2}{3}M_1$ (2) $\frac{1}{2}M_1$ (3) $\frac{1}{3}M_1$ (4) M_1 (5) $2M_1$

16. A firecracker is tossed straight upward into the air. It explodes into three pieces (A, B, and C) of equal mass just as it reaches the highest point. If piece A moves off at a speed of 4 m/s and piece B and C move off with equal speeds of 5 m/s, what is the angle between piece B and C?

(1) 132.8° (2) 106.3° (3) 73.7° (4) 90.0° (5) 62.5°

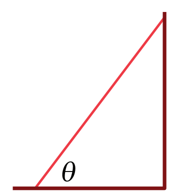
17. A firecracker is tossed straight upward into the air. It explodes into three pieces (A, B, and C) of equal mass just as it reaches the highest point. If piece A moves off at a speed of 6 m/s and piece B and C move off with equal speeds of 5 m/s, what is the angle between piece B and C?

(1) 106.3° (2) 132.8° (3) 73.7° (4) 90.0° (5) 62.5°

18. A firecracker is tossed straight upward into the air. It explodes into three pieces (A, B, and C) of equal mass just as it reaches the highest point. If piece A moves off at a speed of 8 m/s and piece B and C move off with equal speeds of 5 m/s, what is the angle between piece B and C?

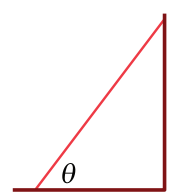
(1) 73.7° (2) 132.8° (3) 106.3° (4) 90.0° (5) 62.5°

19. A 80-N uniform plank leans at rest against a frictionless wall at an angle θ with the horizontal as shown in the figure. If $\theta = 53.13°$, what is the magnitude of the force (in N) applied to the plank by the wall?



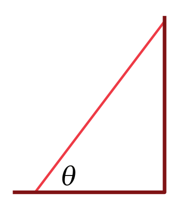
(1) 30 (2) 25 (3) 20 (4) 80 (5) 120

20. A 80-N uniform plank leans at rest against a frictionless wall at an angle θ with the horizontal as shown in the figure. If $\theta = 57.99°$, what is the magnitude of the force (in N) applied to the plank by the wall?



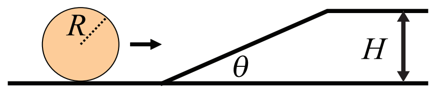
(1) 25 (2) 30 (3) 20 (4) 80 (5) 120

21. A 80-N uniform plank leans at rest against a frictionless wall at an angle θ with the horizontal as shown in the figure. If $\theta = 63.43°$, what is the magnitude of the force (in N) applied to the plank by the wall?



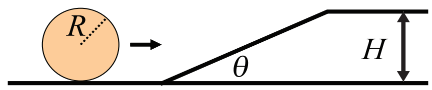
(1) 20 (2) 30 (3) 25 (4) 80 (5) 120

22. Near the surface of the Earth a solid sphere of mass M, radius $R = 0.5$ m, and moment of inertia $I = 2MR^2/5$ rolls along a horizontal surface and up a ramp of height $H = 0.7$ m that makes an angle of $\theta = 20°$ with the horizontal surface as shown in the figure. If the ball rolls without slipping on both the horizontal surface and the ramp, what is the minimum number of revolutions per second the ball must have while rolling on the horizontal surface in order to reach the top of the ramp?



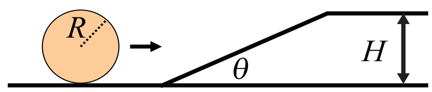
(1) 1.0 (2) 1.2 (3) 1.5 (4) 0.5 (5) 2.0

23. Near the surface of the Earth a solid sphere of mass M, radius $R = 0.5$ m, and moment of inertia $I = 2MR^2/5$ rolls along a horizontal surface and up a ramp of height $H = 1.0$ m that makes an angle of $\theta = 20°$ with the horizontal surface as shown in the figure. If the ball rolls without slipping on both the horizontal surface and the ramp, what is the minimum number of revolutions per second the ball must have while rolling on the horizontal surface in order to reach the top of the ramp?



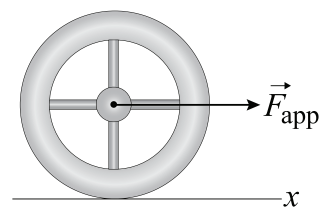
(1) 1.2 (2) 1.0 (3) 1.5 (4) 0.5 (5) 2.0

24. Near the surface of the Earth a solid sphere of mass M, radius $R = 0.5$ m, and moment of inertia $I = 2MR^2/5$ rolls along a horizontal surface and up a ramp of height $H = 1.5$ m that makes an angle of $\theta = 20°$ with the horizontal surface as shown in the figure. If the ball rolls without slipping on both the horizontal surface and the ramp, what is the minimum number of revolutions per second the ball must have while rolling on the horizontal surface in order to reach the top of the ramp?



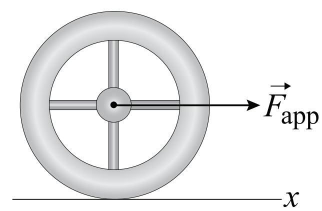
(1) 1.5 (2) 1.0 (3) 1.2 (4) 0.5 (5) 2.0

25. Near the surface of the Earth a constant horizontal force $\vec{F}_{app}$ is applied to a wheel of radius R, mass M, and moment of inertia $I = \frac{3}{4}MR^2$ as shown in the figure. If the coefficient of static friction between the wheel and the horizontal floor is $\mu_s = 0.4$ and if the wheel rolls without slipping, what is the minimum time (in s) necessary for the wheel to start from rest and travel a horizontal distance of 10 meters?



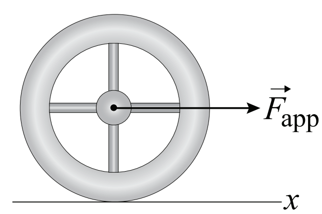
(1) 1.96 (2) 2.77 (3) 3.39 (4) 3.91 (5) 1.57

26. Near the surface of the Earth a constant horizontal force $\vec{F}_{app}$ is applied to a wheel of radius R, mass M, and moment of inertia $I = \frac{3}{4}MR^2$ as shown in the figure. If the coefficient of static friction between the wheel and the horizontal floor is $\mu_s = 0.4$ and if the wheel rolls without slipping, what is the minimum time (in s) necessary for the wheel to start from rest and travel a horizontal distance of 20 meters?



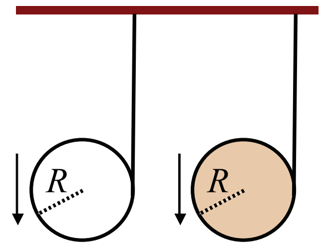
(1) 2.77 (2) 1.96 (3) 3.39 (4) 3.91 (5) 1.57

27. Near the surface of the Earth a constant horizontal force $\vec{F}_{app}$ is applied to a wheel of radius R, mass M, and moment of inertia $I = \frac{3}{4}MR^2$ as shown in the figure. If the coefficient of static friction between the wheel and the horizontal floor is $\mu_s = 0.4$ and if the wheel rolls without slipping, what is the minimum time (in s) necessary for the wheel to start from rest and travel a horizontal distance of 30 meters?



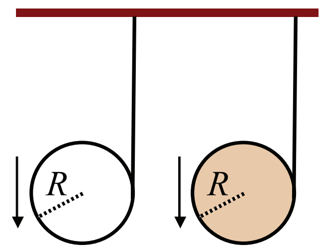
(1) 3.39 (2) 1.96 (3) 2.77 (4) 3.91 (5) 1.57

28. Near the surface of the Earth a cloth tape is wound around the outside of a thin uniform hoop with mass M, radius R, and moment of inertia $I_{\text{hoop}} = MR^2$. A cloth tape is also wound around the outside of a non-uniform cylinder with the same mass M and the same radius R, but with moment of inertia I_{cylinder}. Both the hoop and the cylinder are fastened to the ceiling as shown in the figure. They are both released from rest at $t = 0$ at the same distance from the ceiling. If at $t = 1.28$ s the two objects are a vertical distance of 2 meters apart, what is the moment of inertia of the cylinder I_{cylinder}?



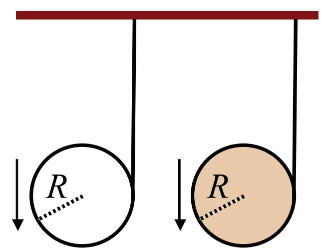
(1) $0.33MR^2$ (2) $0.25MR^2$ (3) $0.60MR^2$ (4) $0.50MR^2$ (5) $0.40MR^2$

29. Near the surface of the Earth a cloth tape is wound around the outside of a thin uniform hoop with mass M, radius R, and moment of inertia $I_{\text{hoop}} = MR^2$. A cloth tape is also wound around the outside of a non-uniform cylinder with the same mass M and the same radius R, but with moment of inertia I_{cylinder}. Both the hoop and the cylinder are fastened to the ceiling as shown in the figure. They are both released from rest at $t = 0$ at the same distance from the ceiling. If at $t = 1.17$ s the two objects are a vertical distance of 2 meters apart, what is the moment of inertia of the cylinder I_{cylinder}?



(1) $0.25MR^2$ (2) $0.33MR^2$ (3) $0.60MR^2$ (4) $0.50MR^2$ (5) $0.40MR^2$

30. Near the surface of the Earth a cloth tape is wound around the outside of a thin uniform hoop with mass M, radius R, and moment of inertia $I_{\text{hoop}} = MR^2$. A cloth tape is also wound around the outside of a non-uniform cylinder with the same mass M and the same radius R, but with moment of inertia I_{cylinder}. Both the hoop and the cylinder are fastened to the ceiling as shown in the figure. They are both released from rest at $t = 0$ at the same distance from the ceiling. If at $t = 1.81$ s the two objects are a vertical distance of 2 meters apart, what is the moment of inertia of the cylinder I_{cylinder}?



(1) $0.60MR^2$ (2) $0.33MR^2$ (3) $0.25MR^2$ (4) $0.50MR^2$ (5) $0.40MR^2$

31. At time $t = 0$ a 2.5 kg particle is located at $\vec{r} = (2m)\hat{x} + (4m)\hat{y}$, and its velocity is $\vec{v} = -(6m/s)\hat{x}$, and it is subject to the force $\vec{F} = (8N)\hat{y}$, where $\hat{x}$ and $\hat{y}$ are unit vectors in the x and y-direction, respectively. What is the magnitude of the angular momentum of the particle about the origin at $t = 0$?

(1) 60 kg·m^2/s (2) 70 kg·m^2/s (3) 80 kg·m^2/s (4) 48 kg·m^2/s (5) 16 kg·m^2/s

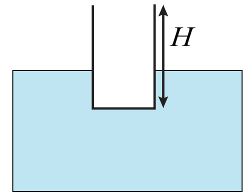
32. At time $t = 0$ a 2.5 kg particle is located at $\vec{r} = (2m)\hat{x} + (4m)\hat{y}$, and its velocity is $\vec{v} = -(7m/s)\hat{x}$, and it is subject to the force $\vec{F} = (8N)\hat{y}$, where $\hat{x}$ and $\hat{y}$ are unit vectors in the x and y-direction, respectively. What is the magnitude of the angular momentum of the particle about the origin at $t = 0$?

(1) 70 kg·m^2/s (2) 60 kg·m^2/s (3) 80 kg·m^2/s (4) 48 kg·m^2/s (5) 16 kg·m^2/s

33. At time $t = 0$ a 2.5 kg particle is located at $\vec{r} = (2m)\hat{x} + (4m)\hat{y}$, and its velocity is $\vec{v} = -(8m/s)\hat{x}$, and it is subject to the force $\vec{F} = (8N)\hat{y}$, where $\hat{x}$ and $\hat{y}$ are unit vectors in the x and y-direction, respectively. What is the magnitude of the angular momentum of the particle about the origin at $t = 0$?

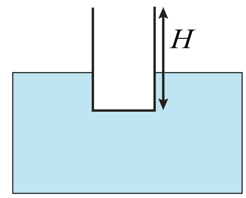
(1) 80 kg·m^2/s (2) 60 kg·m^2/s (3) 70 kg·m^2/s (4) 48 kg·m^2/s (5) 16 kg·m^2/s

34. A large cargo container with a square base with an area of 4 m^2 and height $H = 5$ m floats on the water ($\rho_{\text{water}} = 1,000$ kg/m^3) as shown in the figure. The cargo container is being loaded with small 50-kg boxes. If it can hold a maximum of 250 boxes without sinking, what is the mass (in kg) of the empty cargo container?



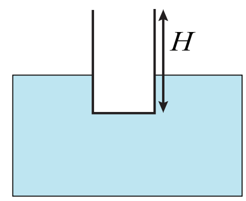
(1) 7,500 (2) 5,000 (3) 2,500 (4) 1,500 (5) 8,000

35. A large cargo container with a square base with an area of 4 m^2 and height $H = 5$ m floats on the water ($\rho_{\text{water}} = 1,000$ kg/m^3) as shown in the figure. The cargo container is being loaded with small 50-kg boxes. If it can hold a maximum of 300 boxes without sinking, what is the mass (in kg) of the empty cargo container?



(1) 5,000 (2) 7,500 (3) 2,500 (4) 1,500 (5) 8,000

36. A large cargo container with a square base with an area of 4 m^2 and height $H = 5$ m floats on the water ($\rho_{\text{water}} = 1,000$ kg/m^3) as shown in the figure. The cargo container is being loaded with small 50-kg boxes. If it can hold a maximum of 350 boxes without sinking, what is the mass (in kg) of the empty cargo container?



(1) 2,500 (2) 7,500 (3) 5,000 (4) 1,500 (5) 8,000

37. A block of wood has a density of 600 kg/m^3. In water (density 1000 kg/m^3) the block floats. If you must supply a downward force of 100 N to fully submerge the block so that it rests just below the water surface, what is the weight of the block of wood (in N)?

(1) 150 (2) 180 (3) 240 (4) 320 (5) 100

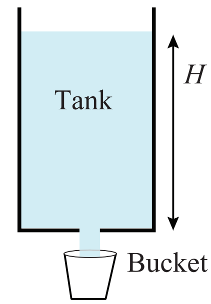
38. A block of wood has a density of 600 kg/m^3. In water (density 1000 kg/m^3) the block floats. If you must supply a downward force of 120 N to fully submerge the block so that it rests just below the water surface, what is the weight of the block of wood (in N)?

(1) 180 (2) 150 (3) 240 (4) 320 (5) 100

39. A block of wood has a density of 600 kg/m^3. In water (density 1000 kg/m^3) the block floats. If you must supply a downward force of 160 N to fully submerge the block so that it rests just below the water surface, what is the weight of the block of wood (in N)?

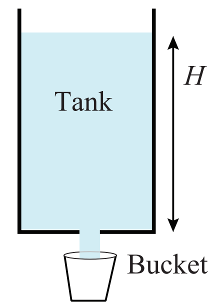
(1) 240 (2) 150 (3) 180 (4) 320 (5) 100

40. Near the surface of the Earth a large water tank, open at the top, has a small hole in the bottom with a diameter of 2.5 cm as shown in the figure. Assume that the area of the top of the tank is much larger than the area of the hole. If it takes 8 seconds to fill up a bucket with a volume of 0.064 m^3 with water from the small hole, how high (in m) is the water level above the bottom of the tank (*i.e.,* what is H)?



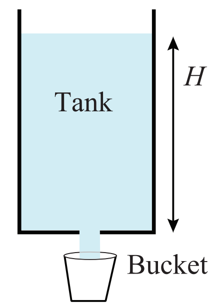
(1) 13.6 (2) 10.7 (3) 8.7 (4) 15.2 (5) 7.3

41. Near the surface of the Earth a large water tank, open at the top, has a small hole in the bottom with a diameter of 2.5 cm as shown in the figure. Assume that the area of the top of the tank is much larger than the area of the hole. If it takes 9 seconds to fill up a bucket with a volume of 0.064 m^3 with water from the small hole, how high (in m) is the water level above the bottom of the tank (*i.e.,* what is H)?



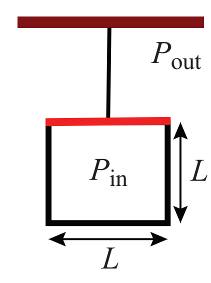
(1) 10.7 (2) 13.6 (3) 8.7 (4) 15.2 (5) 7.3

42. Near the surface of the Earth a large water tank, open at the top, has a small hole in the bottom with a diameter of 2.5 cm as shown in the figure. Assume that the area of the top of the tank is much larger than the area of the hole. If it takes 10 seconds to fill up a bucket with a volume of 0.064 m^3 with water from the small hole, how high (in m) is the water level above the bottom of the tank (*i.e.,* what is H)?



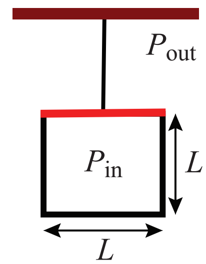
(1) 8.7 (2) 13.6 (3) 10.7 (4) 15.2 (5) 7.3

43. A cubical metal box with sides of mass M and length L has a square lid also with mass M and length L. The lid is not attached to the box, however, the lid and the box form an airtight seal. Near the surface of the Earth, the lid is held at rest by a steel cable, as shown in the figure. The pressure outside the box is the atmospheric pressure, $P_{\text{out}} = P_{\text{atm}} = 101$ kPa. The box is partially evacuated to an inside pressure P_{in} so that the box remains at rest. If $M = 25$ kg and $L = 0.4$ m, what is the maximum inside pressure P_{in} (in kPA) such that the box will not fall?



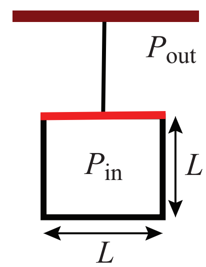
(1) 93.3 (2) 96.1 (3) 97.6 (4) 89.2 (5) 99.8

44. A cubical metal box with sides of mass M and length L has a square lid also with mass M and length L. The lid is not attached to the box, however, the lid and the box form an airtight seal. Near the surface of the Earth, the lid is held at rest by a steel cable, as shown in the figure. The pressure outside the box is the atmospheric pressure, $P_{\text{out}} = P_{\text{atm}} = 101$ kPa. The box is partially evacuated to an inside pressure P_{in} so that the box remains at rest. If $M = 25$ kg and $L = 0.5$ m, what is the maximum inside pressure P_{in} (in kPA) such that the box will not fall?



(1) 96.1 (2) 93.3 (3) 97.6 (4) 89.2 (5) 99.8

45. A cubical metal box with sides of mass M and length L has a square lid also with mass M and length L. The lid is not attached to the box, however, the lid and the box form an airtight seal. Near the surface of the Earth, the lid is held at rest by a steel cable, as shown in the figure. The pressure outside the box is the atmospheric pressure, $P_{\text{out}} = P_{\text{atm}} = 101$ kPa. The box is partially evacuated to an inside pressure P_{in} so that the box remains at rest. If $M = 25$ kg and $L = 0.6$ m, what is the maximum inside pressure P_{in} (in kPA) such that the box will not fall?



(1) 97.6 (2) 93.3 (3) 96.1 (4) 89.2 (5) 99.8

46. When a stone of weight W is suspended from a scale and submerged in water the scale reads 9 N. When the same stone is suspended from a scale and submerged in oil the scale reads 12 N. If the density of the oil is 0.8 the density of the water (*i.e.,* $\rho_{\text{oil}} = 0.8\rho_{\text{water}}$), what is the true weight W (in N) of the stone (*i.e.,* its weight in a vacuum)?

(1) 24 (2) 21 (3) 39 (4) 18 (5) 14

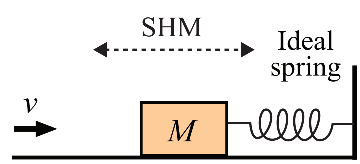
47. When a stone of weight W is suspended from a scale and submerged in water the scale reads 9 N. When the same stone is suspended from a scale and submerged in oil the scale reads 12 N. If the density of the oil is 0.75 the density of the water (*i.e.,* $\rho_{\text{oil}} = 0.75\rho_{\text{water}}$), what is the true weight W (in N) of the stone (*i.e.,* its weight in a vacuum)?

(1) 21 (2) 24 (3) 39 (4) 18 (5) 14

48. When a stone of weight W is suspended from a scale and submerged in water the scale reads 9 N. When the same stone is suspended from a scale and submerged in oil the scale reads 12 N. If the density of the oil is 0.9 the density of the water (*i.e.,* $\rho_{\text{oil}} = 0.9\rho_{\text{water}}$), what is the true weight W (in N) of the stone (*i.e.,* its weight in a vacuum)?

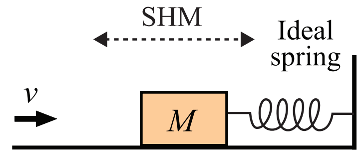
(1) 39 (2) 24 (3) 21 (4) 18 (5) 14

49. A block of mass $M = 2$ kg is connected to an ideal spring on a horizontal frictionless surface as shown in the figure. The block is undergoing simple harmonic motion (SHM) with period $T = 2$ s and with an amplitude of the oscillations of 2 m. A 50-gram bullet traveling horizontally at $v = 250$ m/s strikes the oscillating block precisely at the moment when the block has zero velocity and becomes embedded in the block. What is the new amplitude (in m) of the oscillations of the subsequent simple harmonic motion of the bullet-block system?



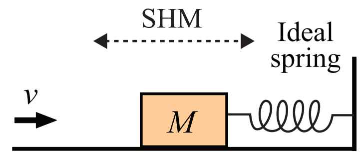
(1) 2.8 (2) 3.6 (3) 4.4 (4) 2.0 (5) 1.5

50. A block of mass $M = 2$ kg is connected to an ideal spring on a horizontal frictionless surface as shown in the figure. The block is undergoing simple harmonic motion (SHM) with period $T = 3$ s and with an amplitude of the oscillations of 2 m. A 50-gram bullet traveling horizontally at $v = 250$ m/s strikes the oscillating block precisely at the moment when the block has zero velocity and becomes embedded in the block. What is the new amplitude (in m) of the oscillations of the subsequent simple harmonic motion of the bullet-block system?



(1) 3.6 (2) 2.8 (3) 4.4 (4) 2.0 (5) 1.5

51. A block of mass $M = 2$ kg is connected to an ideal spring on a horizontal frictionless surface as shown in the figure. The block is undergoing simple harmonic motion (SHM) with period $T = 4$ s and with an amplitude of the oscillations of 2 m. A 50-gram bullet traveling horizontally at $v = 250$ m/s strikes the oscillating block precisely at the moment when the block has zero velocity and becomes embedded in the block. What is the new amplitude (in m) of the oscillations of the subsequent simple harmonic motion of the bullet-block system?



(1) 4.4 (2) 2.8 (3) 3.6 (4) 2.0 (5) 1.5

52. An ideal spring-and-mass system is undergoing simple harmonic motion (SHM) with a period of oscillation $T = 2$ s. If the speed of the block is 1.0 m/s when the displacement from equilibrium is 2.0 m, what is the speed of the block (in m/s) when the displacement from equilibrium is 1.0 m?

(1) 5.5 (2) 3.8 (3) 2.9 (4) 6.2 (5) 1.9

53. An ideal spring-and-mass system is undergoing simple harmonic motion (SHM) with a period of oscillation $T = 3$ s. If the speed of the block is 1.0 m/s when the displacement from equilibrium is 2.0 m, what is the speed of the block (in m/s) when the displacement from equilibrium is 1.0 m?

(1) 3.8 (2) 5.5 (3) 2.9 (4) 6.2 (5) 1.9

54. An ideal spring-and-mass system is undergoing simple harmonic motion (SHM) with a period of oscillation $T = 4$ s. If the speed of the block is 1.0 m/s when the displacement from equilibrium is 2.0 m, what is the speed of the block (in m/s) when the displacement from equilibrium is 1.0 m?

(1) 2.9 (2) 5.5 (3) 3.8 (4) 6.2 (5) 1.9

55. The atmospheric pressure at the surface of a clear lake near the surface of the Earth is 101 kPA. If the bulk modulus for water is 2.2×10^9Pa, by what percentage does the density of the lake water increase at a depth of 1.5 km below the surface of the lake?

(1) 0.673% (2) 0.899% (3) 1.126% (4) 0.447% (5) 1.725%

56. The atmospheric pressure at the surface of a clear lake near the surface of the Earth is 101 kPA. If the bulk modulus for water is 2.2×10^9Pa, by what percentage does the density of the lake water increase at a depth of 2.0 km below the surface of the lake?

(1) 0.899% (2) 0.673% (3) 1.126% (4) 0.447% (5) 1.725%

57. The atmospheric pressure at the surface of a clear lake near the surface of the Earth is 101 kPA. If the bulk modulus for water is 2.2×10^9Pa, by what percentage does the density of the lake water increase at a depth of 2.5 km below the surface of the lake?

(1) 1.126% (2) 0.673% (3) 0.899% (4) 0.447% (5) 1.725%

58. A simple pendulum has period $T = 4$ s when it is on the surface of the Earth (gravitational acceleration $g = 9.8$ m/s^2). If on the surface of planet X its period is 3.0 s, what is the gravitational acceleration (in m/s^2) at the surface of planet X?

(1) 17.4 (2) 25.1 (3) 39.2 (4) 5.5 (5) 3.8

59. A simple pendulum has period $T = 4$ s when it is on the surface of the Earth (gravitational acceleration $g = 9.8$ m/s^2). If on the surface of planet X its period is 2.5 s, what is the gravitational acceleration (in m/s^2) at the surface of planet X?

(1) 25.1 (2) 17.4 (3) 39.2 (4) 5.5 (5) 3.8

60. A simple pendulum has period $T = 4$ s when it is on the surface of the Earth (gravitational acceleration $g = 9.8$ m/s^2). If on the surface of planet X its period is 2.0 s, what is the gravitational acceleration (in m/s^2) at the surface of planet X?

(1) 39.2 (2) 17.4 (3) 25.1 (4) 5.5 (5) 2.5

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