Activity 26
Practice Exam #3 - PHYS 1

This is a regular activity. This activity counts an activity credit (10 points for a regular activity). There will be one such *practice* exam for each monthly exam and final exam.

To receive the activity credit point for this activity, you must work in the class.

This activity of practice exam may not cover all the topics that may appear in the monthly exam, but has a similar format.

In the monthly exam there will be a bubble sheet for you to print your name and section number and to fill your RIN number and answers.

In the monthly exam only answers filled on the bubble sheet will be graded.

Cheating on any monthly exam will result in an F in the course.

1. Three objects, a disk ($I = \frac{1}{2}MR^2$), a solid sphere ($I = \frac{2}{5}MR^2$), and a hoop ($I = MR^2$), all with the same mass and radius, are at rest on top of an inclined plane. They simultaneously begin to roll down the incline plane without slipping. Which object will arrive first at the bottom?

A) The hoop will arrive first at the bottom.
B) The sphere will arrive first at the bottom.
C) The disc will arrive first at the bottom.
D) They will arrive at the bottom at the same time.

2. A uniform solid sphere ($I = \frac{2}{5}MR^2$) is rolling without slipping along a horizontal surface with a speed of 5.50 m/s when it starts up a ramp that makes an angle of 25.0° with the horizontal. What is the speed of the sphere after it has rolled 3.00 m up the ramp, measured along the surface of the ramp?

A) 8.02 m/s
B) 1.91 m/s
C) 2.16 m/s
D) 3.53 m/s

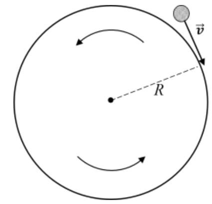
3. A uniform solid cylindrical log ($I = \frac{1}{2}MR^2$) begins rolling without slipping down a ramp that rises 28.0° above the horizontal. After it has rolled 4.20 m along the ramp, what is the magnitude of the linear acceleration of its center of mass?

A. 9.80 m/s^2
B. 4.60 m/s^2
C. 3.29 m/s^2
D. 3.07 m/s^2

4. Two uniform disks rotate independently around a common axis. One of the disks rotates in one direction at 1.00 rad/s and the other rotates in the opposite direction at 2.00 rad/s. Each flywheel has the same rotational inertia of 50.0 kg•m^2. Calculate the <u>magnitude</u> of the net angular momentum of the system.

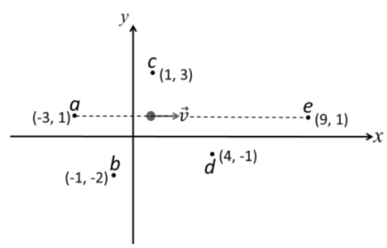
A. 20 kg•m^2/s
B. 30 kg•m^2/s
C. 40 kg•m^2/s
D. 50 kg•m^2/s

5. A uniform wooden disk of mass $M = 4.0$ kg and radius $R = 0.50$ m is on a frictionless horizontal surface and rotates with an angular speed $\omega_d = 2.5$ rad/s about a vertical axle through its center. The figure at right shows the disk and its sense of rotation when viewed from above. A very small ball of putty with mass $m = 0.50$ kg slides along the surface toward the disk at speed $|\vec{v}| = 3.0$ m/s, directed along a line tangent to the disk's edge (i.e., perpendicular to the radial line shown in the figure). The putty ball sticks to the edge of the disk, and afterward they rotate as a single unit. Given that the moment of inertia of the disk about its central axle is $I = ½ MR^2$, the angular speed of the disk+putty ball system ω_{d+m} after they stick together is



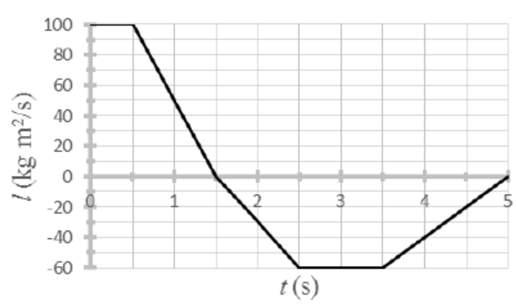
A) 0.50 rad/s.
B) 2.0 rad/s.
C) 0.80 rad/s.
D) 1.6 rad/s.

6. The figure shows a particle moving at a constant velocity $\vec{v}$. There are five points a, b, c, d, and e with their x and y coordinates labeled. Rank the points according to the <u>magnitude</u> of the angular momentum of the particle measured about each point, greatest first.



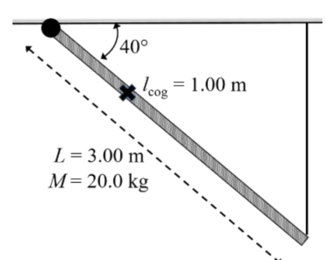
A) b > c > d > e > a
B) e > c > b > d > a
C) e > b > d > a > c
D) b > d = c > a = e

7. A disk of radius $R = 1.5$ m and mass $M = 20$ kg rotates around a fixed axis passing through its center. The graph shows the angular momentum l of the disk along the rotation axis as a function of time t. The net external torque acting on the disk at $t = 2.0$ s is



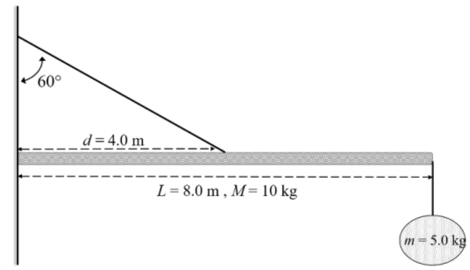
A) 60 Nm.
B) 15 Nm.
C) −15 Nm.
D) −60 Nm.

8. A *non*uniform beam of mass $M = 20.0$ kg and length $L = 3.00$ m is suspended from a ceiling at an angle of 40° below the horizontal. The pole is attached to the ceiling by a hinge at one end and a support rope attached to the other end. The center of gravity of the beam (located at the "✖" in the figure) is a distance $l_{cog} = 1.00$ m from the pivot. The tension in the support rope is



A) 196 N.
B) 50.0 N.
C) 65.3 N.
D) 42.0 N.

9. A mass m = 5.0 kg is suspended by a rope at the end of a uniform horizontal pole of length L = 8.0 m and mass M = 10 kg. The pole is attached at one end to a vertical wall by a hinge. A cable affixed to the wall and connected to the pole a distance d = 4.0 m from the wall also helps to support the pole. The cable makes an angle of 60° with respect to the wall. The normal force that the wall exerts on the pole is

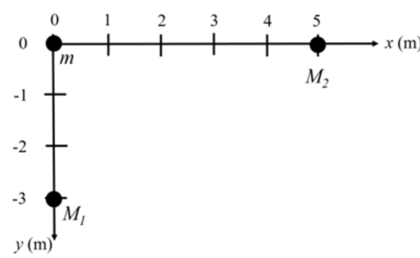


A) 200 N.
B) 470 N.
C) 160 N.
D) 340 N.

10. The mass of the Moon is 1/81 of the mass of the Earth. Compared to the gravitational force that the earth exerts on the Moon, the gravitational force that the Moon exerts on the Earth is

A) 81^2 times greater.
B) 81 times greater.
C) equally strong.
D) $(1/81)^2$ as great.

11. Three masses lie in the z = 0 plane of a Cartesian coordinate system. The figure at right shows the x- and y-coordinates of masses m = 10 kg, M_1 = 30 kg, and M_2 = 50 kg. The masses are spherical and have radii that are much smaller than the distances separating one another. They can all therefore be treated as point masses. Find the magnitude of the net gravitational force F_G that M_1 and M_2 exert on m. The gravitational constant $G = 6.67 \times 10^{-11}\ \mathrm{Nm^2/kg^2}$.

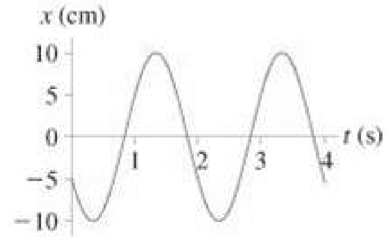


A) 2.59×10^{-9}N
B) 1.27×10^{-8}N
C) 3.55×10^{-9}N
D) 8.89×10^{-10}N

12. A small asteroid of mass $m = 1.50 \times 10^{13}$ kg collides with the planet Mars. The speed of the asteroid when it was very far from the planet was 3.60×10^3 m/s. Given that Mars has a mass $M = 6.42 \times 10^{23}$ kg and a radius $R = 3.39 \times 10^6$ m, and that the gravitational constant $G = 6.67 \times 10^{-11}\ \mathrm{Nm^2/kg^2}$, the speed at which the asteroid impacts the Martian surface is

A) 8.63×10^3 m/s.
B) 4.29×10^3 m/s.
C) 6.18×10^3 m/s.
D) 7.15×10^3 m/s.

13. The figure given below depicts the oscillation of an oscillator. The *mathematical expression of the oscillation is* $x(t) = x_m cos(\omega t+\varphi)$. What is the phase constant, φ, of the oscillation?



A) 1.4 radians
B) 2.1 radians
C) 3.2 radians
D) 3.7 radians

14. For a simple harmonic motion (SHM) the displacement x of the particle from the origin is given as a function of time by $x(t) = x_m \cos(\omega t + \phi)$, where the x_m is the maximum displacement in units of meter, ω is the angular frequency in units of rad/s, and ϕ is the phase constant. If the SHM is described as $x(t) = 0.5 \cos(20\,t + \phi)$, the magnitude of the maximum acceleration is

A) 10 m/s^2
B) 200 m/s^2
C) 100 m/s^2
D) 20 m/s^2

15. A simple harmonic oscillator has an amplitude of 2.00 cm and a maximum speed of 13.0 cm/s. What is its speed when the displacement is 1.00 cm?

A) 9.24 cm/s
B) 11.3 cm/s
C) 14.2 cm/s
D) 15.0 cm/s

16. Consider a traveling wave described by the formula, $y(x,t) = y_m sin\,(kx - \omega t)$. Which one of the following statements about the wave described in the formula is correct?

A) The wave is traveling in the +x direction
B) The wave is traveling in the −x direction
C) The wave is oscillating but not traveling
D) The wave is traveling but not oscillating

17. A uniform piece of string with a length L = 5.00 m and mass m = 0.0100 kg is held taut by an unknown tension F_T applied at both ends of the string. The string is plucked and transverse waves obeying the relation

$$y(x,t) = (8.50\text{ mm})\sin[(180\text{ rad/m})x - (4900\text{ rad/s})t]$$

are generated in the string. The tension F_T is

A) 0.675 N
B) 3.84 N
C) 1.48 N
D) 0.0544 N.

18. Four traveling waves are described by the following equations, where all quantities are measured in SI units and y represents the displacement.

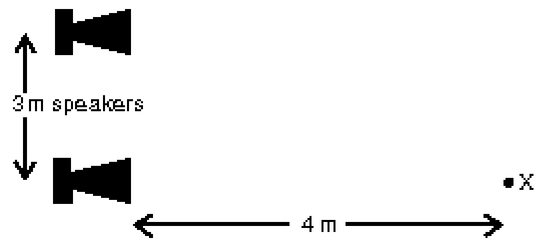
I: $y = 0.12 \cos(3x - 21t)$
II: $y = 0.15 \sin(6x + 42t)$
III: $y = 0.13 \cos(6x + 21t)$
IV: $y = -0.27 \sin(3x - 42t)$

Which of these waves have the same period?

A) I and III, and also II and IV
B) I and IV, and also II and III
C) I and II, and also III and IV
D) All of them have the same period.

19. Two small identical speakers are connected (in phase) to the same source. The speakers are 3 m apart and at ear level. An observer stands at X, 4 m in front of one speaker as shown. If the amplitudes are not changed, the sound the observer hears will be least intense if the wavelength is:

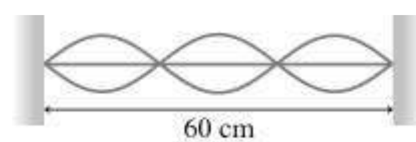
A) 1m
B) 2m
C) 3m
D) 4m



20. Consider a wave of the form, $y(x,t) = 1.0\,sin(10x)\cos(2.0t)$, where t is the time.

A) This wave is traveling in the $+x$ direction.
B) This wave is traveling in the $-x$ direction.
C) This wave is oscillating but not traveling.
D) This wave is traveling but not oscillating.

21. A standing wave is oscillating at 700 Hz on a string, as shown in the figure. What is the speed of traveling waves on this string?



A) 280 m/s
B) 410 m/s
C) 210 m/s
D) 140 m/s

22. Standing waves of frequency 57.0 Hz are produced on a string that has mass per unit length 0.0160 kg/m. With what tension must the string be stretched between two supports if adjacent nodes in the standing wave are to be 0.710 meters apart?

A) 105 N
B) 195 N
C) 245 N
D) 307 N

23. A church pipe organ consists of several pipes that generate sound waves. Pipe A of the organ is open at both ends and has a length L. Pipe B of the organ is identical to A, except that it has one open end and one closed end. When A is played in its third harmonic and B is played in its fundamental mode, beats having a frequency f_b = 86 Hz are generated. Given that the speed of sound when the beats are created is v = 344 m/s, the length of pipes A and B is

A) 10 m.
B) 5.0 m.
C) 3.5 m.
D) 2.0 m.

24. Shock waves occur when

A) the frequency of the waves is the resonant frequency of the system.
B) the amplitude of waves exceeds the critical shock value.
C) two waves from different sources collide with each other.
D) the wave source is traveling at a speed greater than the wave speed.

25. A stationary listener (observer O) is between two stereo speakers (1 and 2) as shown in the figure. The speakers are identical in all ways, including the frequency and phase at which they emit sound waves. Speaker 1 is at rest and emits a steady tone at frequency f_1 = 400 Hz. Speaker 2 also emits a steady tone at the same frequency (f_2 = 400 Hz), but is moving toward O at a speed v_2. The tones from the two speakers generate beats at O's location. If O hears 50.0 beats in 10.0 seconds, and the speed of sound in air is 344 m/s, v_2 is

A) 4.25 m/s.
B) 38.2 m/s.
C) 2.66 m/s.
D) 9.33 m/s.