MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) How long does it take a wheel that is rotating at 33.3 rpm to speed up to 78.0 rpm if it has an angular acceleration of 2.15 rad/s²?
   A) 20.8 s         B) 10.4 s         C) 2.18 s         D) 5.20 s

2) The moment of inertia of a uniform rod (about its center) is given by \( I = ML^2/12 \). What is the kinetic energy of a 120-cm rod with a mass of 450 g rotating about its center at 3.60 rad/s?
   A) 0.350 J         B) 4.20 J         C) 0.700 J         D) 2.10 J

3) The drive chain in a bicycle is applying a torque of 0.850 Nm to the wheel of the bicycle. Treat the wheel as a hoop with a mass of 0.750 kg and a radius of 33.0 cm. What is the angular acceleration of the wheel?
   A) 10.4 rad/s²     B) 5.20 rad/s²   C) 3.43 rad/s²     D) 1.06 rad/s²

4) A figure skater is spinning slowly with arms outstretched. She brings her arms in close to her body and her angular speed increases dramatically. The speed increase is a demonstration of
   A) conservation of energy: her moment of inertia is decreased, and so her angular speed must increase to conserve energy.
   B) conservation of angular momentum: her moment of inertia is decreased, and so her angular speed must increase to conserve angular momentum.
   C) Newton’s second law for rotational motion: she exerts a torque and so her angular speed increases.
   D) This has nothing to do with mechanics, it is simply a result of her natural ability to perform.

5) Two identical spheres, each of mass \( M \) and radius \( R \) just touch each other. What is the magnitude of the gravitational force that they exert on each other?
   A) \( GM^2/R^2 \)     B) \( GM^2/2R^2 \)     C) \( GM^2/4R^2 \)     D) \( 2GM^2/R^2 \)

6) A satellite completes one full orbit around Earth. The work performed by Earth’s gravitational force on the satellite is
   A) always positive.     B) zero J.     C) always negative.     D) positive most of the time.

7) In simple harmonic motion, the speed is greatest at that point in the cycle when
   A) the magnitude of the acceleration is a maximum.     B) the displacement is a maximum.
   C) the magnitude of the acceleration is a minimum.     D) the potential energy is a maximum.

8) A pendulum that was originally erected by Foucault at the Pantheon in Paris for the Paris Exhibition in 1851 was restored in 1995. It has a 28.0 kg sphere suspended from a 67.0-m light cable. How long would it take for the bob in this pendulum to move from the position of maximum displacement back to the equilibrium point?
   A) 4.11 s         B) 21.5 s         C) 32.2 s         D) 42.9 s
9) A harmonic wave travels with a speed of 200 m/s and has a wavelength of 0.800 m. What is the period of the wave?
   A) 40.0 Hz  B) 125 Hz  C) 80.0 Hz  D) 250 Hz

10) The pitch of a sound is determined by
    A) the amplitude.  B) the speed.  C) the frequency.  D) the wavelength.

11) To measure the speed of light, Fizeau used a rotating disk with equally spaced holes through which light could pass. Light was directed at the rotating disk, passed through one of the holes, bounced from a distant mirror, and then the angular speed of the wheel was adjusted until the returning beam of light passed through the next hole in the disk. In one such experiment, the holes are placed every 0.500 degree and the mirror is 20.0 km away. If the speed of light is 3.00 x 10^8 m/s, at what angular speed of the disk will the returning light pass through the next hole?
    A) 1250 rpm  B) 625 rpm  C) 2500 rpm  D) 398 rpm

12) A pulley has an initial angular speed of 12.5 rad/s and a constant angular acceleration of 3.41 rad/s^2. Through what angle does the pulley turn in 5.26 s?
    A) 113 rad  B) 42.6 rad  C) 19.3 rad  D) 160 rad

13) Earth circles the sun at a distance of 1.50 x 10^{11} m. What is the magnitude of the centripetal acceleration of Earth in its orbit?
    A) 0.00595 m/s^2  B) 0.00148 m/s^2  C) 0.0238 m/s^2  D) 0.000372 m/s^2

14) A soccer ball whose radius is 11 cm rolls a distance of 10 m in 3.50 s. What is the angular speed of the ball?
    A) 13 m/s  B) 26 m/s  C) 39 m/s  D) 52 m/s

15) What is the correct expression for torque, in terms of the magnitude of the force, \( F \), the radial distance from the axis of rotation, \( r \), and the angle between the force and the radial line, \( \theta \)?
    A) \( \tau = F r \sin \theta \)  B) \( \tau = F r \cos \theta \)  C) \( \tau = F r \tan \theta \)  D) \( \tau = F r \theta \)

16) The rotating systems shown in the figure differ only in that the two identical movable masses are positioned a distance \( r \) from the axis of rotation (left), or a distance \( r/2 \) from the axis of rotation (right). If you release the hanging blocks simultaneously from rest, and call \( t_L \) the time taken by the block on the left and \( t_R \) the time taken by the block on the right to reach the bottom, respectively, then

![Diagram of two systems with blocks and悬挂](image_url)

    A) \( t_L = \frac{1}{2} t_R \).  B) \( t_L = t_R \).  C) \( t_L = \sqrt{2} t_R \).  D) \( t_L = 2 t_R \).

17) To determine the location of the center of mass of a car, the car is driven over a scale. When the front wheels are over the scale, the weight recorded by the scale is 5800 N, and when the rear wheels are over the scale, the scale reads 6500 N. The distance between the front and rear wheels is 3.20 m. How far behind the front wheels is the center of mass located?
    A) 1.50 m  B) 1.59 m  C) 1.69 m  D) 1.72 m
18) A store's sign, with a mass of 20.0 kg and 3.00 m long, has its center of gravity at the center of the sign. It is supported by a loose bolt attached to the wall at one end and by a wire at the other end, as shown in Figure 11-2. The wire makes an angle of 25.0° with the horizontal. What is the magnitude of the force exerted by the bolt on the sign?
   A) 464 N  B) 232 N  C) 196 N  D) 297 N

19) A croquet mallet balances when suspended from its center of mass, as shown in the figure (left). If you cut the mallet in two at its center of mass, as shown, how do the masses of the two pieces compare?
   A) The masses are equal.
   B) The piece with the head of the mallet has the greater mass.
   C) The piece with the head of the mallet has the smaller mass.
   D) It is impossible to tell.

20) If your heart is beating at 76.0 beats per minute, what is the frequency of your heart's oscillations?
   A) 4560 Hz  B) 1450 Hz  C) 3.98 Hz  D) 1.27 Hz

21) The position of an air-track cart that is oscillating on a spring is given by \( x = (12.4 \text{ cm}) \cos[(6.35 \text{ s}^{-1})t] \). At what value of \( t \) after \( t = 0 \text{ s} \) is the cart first located at \( x = 8.47 \text{ cm} \)?
   A) 4.34 s  B) 0.108 s  C) 0.129 s  D) 7.39 s

22) A simple harmonic oscillator has an amplitude of 3.50 cm and a maximum speed of 20.0 cm/s. What is its speed when the displacement is 1.75 cm?
   A) 12.0 cm/s  B) 17.3 cm/s  C) 14.2 cm/s  D) 17.0 cm/s

23) A sewing machine needle moves up and down in simple harmonic motion with an amplitude of 1.27 cm and a frequency of 2.55 Hz. What is the maximum speed of the needle?
   A) 3.18 cm/s  B) 20.3 cm/s  C) 10.1 cm/s  D) 6.36 cm/s
24) The speed of surface waves in deep water is given by \( v = gT / 2\pi \). What is the wavelength of a wave that has a period of 3.00 s?
   A) 29.4 m   B) 14.1 m   C) 44.1 m   D) 39.4 m

25) Two steel wires are stretched with the same tension. The first wire has a diameter of 0.590 mm and the second wire has a diameter of 0.890 mm. If the speed of waves traveling along the first wire is 54.0 m/s, what is the speed of waves traveling along the second wire?
   A) 24.9 m/s   B) 27.2 m/s   C) 35.8 m/s   D) 81.0 m/s

26) The vertical displacement of a string is given by \( y(x,t) = (6.00 \text{ mm}) \cos[(3.25 \text{ m}^{-1})x - (7.22 \text{ s}^{-1})t] \). What is the wavelength of the wave?
   A) 1.93 m   B) 0.870 m   C) 0.308 m   D) 0.139 m

27) The speed of sound through the ground is about 6.0 km/s while the speed of sound in air is 343 m/s. A very powerful explosion occurs some distance away and you hear the sound of the explosion. How far away is the explosion?
   A) 20 km   B) 22 km   C) 25 km   D) 27 km

28) Seven seconds after a brilliant flash of lightning, thunder shakes the house. How far was the lightning strike from the house?
   A) Much closer than one kilometer   B) About one kilometer away
   C) About two kilometers away   D) Much farther away than two kilometers
Answer Key
Testname: PHY2053-SAMPLE-TEST3.TST

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) C
2) A
3) A
4) B
5) C
6) B
7) C
8) A
9) D
10) C
11) B
12) A
13) A
14) B
15) A
16) C
17) C
18) B
19) B
20) D
21) C
22) B
23) B
24) B
25) C
26) A
27) B
28) C