Name _____

Exam #3, Physics 1100, Spring 2019

Print your name and section number and fill your RIN number on the bubble sheet provided. Also circle your section number below.

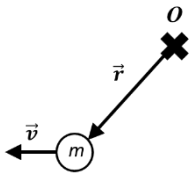
Please return this exam booklet with your bubble sheet

Section	Class	Exam Room
1	M/R 8 am, in 2C06, **Georg**	DCC 308
3	M/R 10 am, in 2C06, **Lu**	DCC 308
5	M/R noon, in 2C06, **Michael**	DCC 318
6	M/R 2 pm, in 2C06, **Kim**	Sage 3303
7	T/F 10 am, in 2C06, **Washington**	DCC 324
8	T/F noon, in 2C30, **Kim**	Sage 3303
9	T/F noon, in 2C06, **Georg**	DCC 308
10	T/F 2 pm, in 2C30, **Michael**	DCC 318
11	M/R 10 am, in 2C30, **Wilke**	DCC 308
12	M/R noon, in 2C30, **Kim**	Sage 3303
13	M/R 4 pm, in 2C06, **Zhang**	DCC 308
14	T/F 10 am, in 2C30, **Lin**	DCC 308

Cheating on this exam will result in an F in the course.

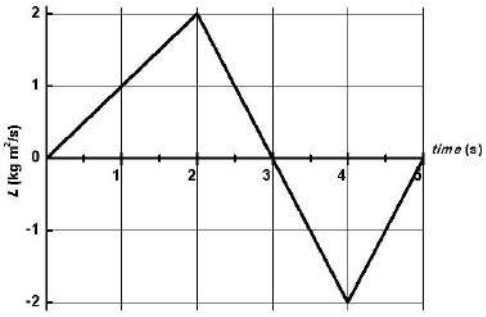
Choose the single best answer. Fill your choice on the bubble sheet provided.

1. A mass *m* in the figure moves to the left at constant speed. What happens to the mass's angular momentum around the rotational axis *O* (which is perpendicular to the page)?



A) Increase.
B) Decrease.
C) Remain the same.
D) Decrease and increase.
E) Increase and Decrease.

2. An object rotates around a fixed axis. The graph at right shows the angular momentum *L* of the object as a function of time *t*. The angular acceleration of the object at $t = 2.5$ s is -0.50 s^{-2}. What is the rotational inertia of the object?



A) 1.0 kg·m^2
B) 2.0 kg·m^2
C) 3.0 kg·m^2
D) 4.0 kg·m^2
E) 5.0 kg·m^2

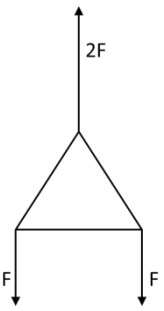
3. Two disks rotate independently around a common axis. One disk rotates in one direction at 5.00 rad/s and the other rotates in the opposite direction at 4.00 rad/s. Each disk has the same rotational inertia of 20.0 kg·m^2. What is the magnitude of the net angular momentum of the system?

A) 20.0 kg·m^2/s B) 45.0 kg·m^2/s C) 70.0 kg·m^2/s D) 115 kg·m^2/s E) 140 kg·m^2/s

4. A thin uniform rod has a length of 0.480 m and is rotating on a frictionless table. The axis of rotation is perpendicular to the length of the rod at one end and is fixed. The rod has an angular velocity of 0.340 rad/s and a moment of inertia about the axis of 3.20×10^{-3} kg·m^2. A bug initially standing at the axis of rotation of the rod decides to crawl out to the other end of the rod. When the bug has reached the end of the rod and sits there, its angular velocity is 0.215 rad/s. The bug can be treated as a point mass. What is the mass of the bug?

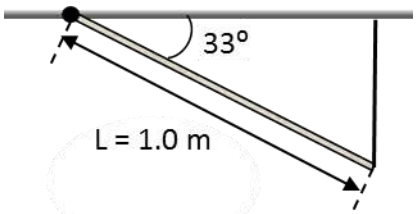
A) 0.00324 kg
B) 0.00807 kg
C) 0.0145 kg
D) 0.0197 kg
E) 0.0214 kg

5. Only three forces act on a uniform triangle as shown in the figure. Two of the forces have a magnitude F and one of the forces has a magnitude 2F. Each force acts at a corner of the equilateral triangle and is either parallel or antiparallel to the others. Which of the statements is true?



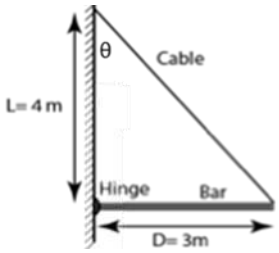
A) The triangle is acted by a torque.
B) The triangle is in rotational equilibrium but not translational equilibrium.
C) The triangle is in rotational and translational equilibrium.
D) The triangle is in translational equilibrium but not rotational equilibrium.
E) The center of the triangle is accelerating.

6. A uniform beam of mass M = 5.00 kg and length L = 1.00 m is suspended from a ceiling at an angle of 33.0° below the horizontal. The beam is attached to the ceiling by a hinge at one end and a light support rope attached to the other end. The tension in the support rope is



A) 24.5 N
B) 37.5 N
C) 49.0 N
D) 54.0 N
E) 65.0 N

7. A horizontal bar is supported by a hinge and a cable as shown in the figure. The bar is homogenous with length D = 3.0 m, and mass m = 8.0 kg. The cable is massless, and connected to the wall at the point which is L= 4.0 m above the bar. The angle θ = 36.8°. What is the magnitude of the tension in the cable?



A) 49 N
B) 66 N
C) 98 N
D) 13 N
E) 25 N

8. A very light ball is located at the surface of the earth. Which statements about it are correct?

A) The earth exerts a much greater gravitational force on the ball than the ball exerts on the earth.
B) The ball exerts a greater gravitational force on the earth than the earth exerts on the ball.
C) The gravitational force on the ball due to the earth is exactly the same as the gravitational force on the earth due to the ball.
D) The gravitational force on the ball is independent of the mass of the ball.
E) The gravitational force on the ball is independent of the mass of the earth.

9. A 155 kg point mass is located 1.50 m from a 275 kg point mass, with both masses fixed in place. Where should you place the third point mass so that the net gravitational force on the third point mass due to the original two masses is zero?

A) 0.436 m from the 155 kg mass along the line connecting the two given masses.
B) 0.559 m from the 155 kg mass along the line connecting the two given masses.
C) 0.643 m from the 155 kg mass along the line connecting the two given masses.
D) 0.759 m from the 155 kg mass along the line connecting the two given masses.
E) 0.843 m from the 155 kg mass along the line connecting the two given masses.

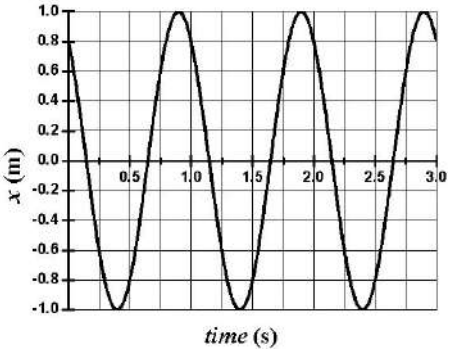
10. A rocket is launched straight up from the earth's surface at a speed of 1.90×10^4 m/s. What is its speed when it is very far (say, r = ∞) away from the earth? (The mass of Earth $M_e = 5.98\times10^{24}$ kg, the radius of Earth $R_e = 6.37\times10^6$ m, and Gravitational Constant $G = 6.67 \times 10^{-11}\ \mathrm{Nm^2/kg^2}$)

A) 0.52×10^3 m/s
B) 0.77×10^3 m/s
C) 1.05×10^4 m/s
D) 1.54×10^4 m/s
E) 2.37×10^4 m/s

11. In simple harmonic motion, the speed is zero at that point in the cycle when
A) the magnitude of the acceleration is zero.
B) the magnitude of the displacement is zero.
C) the magnitude of the force is a maximum.
D) the potential energy is zero.
E) the kinetic energy is a maximum.

12. A block on a horizontal frictionless surface is attached to an ideal massless spring whose spring constant is 150 N/m The block is pulled from its equilibrium position to x = +0.080 m and is released from rest. The block then executes simple harmonic motion along the horizontal x-axis. When the displacement of the block from the equilibrium position is 0.024 m what is the kinetic energy of the block?
A) 0.44 J
B) 0.32 J
C) 0.79 J
D) 0.99 J
E) 0.57 J

(**Q. 13-15)** A block is attached to the end of an ideal spring with force constant k = 4.9 N/m and is moving in simple harmonic motion on a smooth and level floor. The graph at right shows the displacement of the block from equilibrium as a function of time. The curve is represented by the relation, $x(t) = x_m \cos(\omega t + \varphi)$.



13. What is the phase constant φ?
A) -0.64 rad B) 0.64 rad C) -2.5 rad D) 2.5 rad E) -1.6 rad

14. What is the mass of the block?
A) 0.1 kg B) 0.2 kg C) 0.3 kg D) 0.4kg E) 0.5 kg

15. The maximum acceleration of the block is
A) 1.0 m/s^2. B) 3.1 m/s^2. C) 6.3 m/s^2. D) 7.5 m/s^2. E) 39 m/s^2.

16. A wave in which the particles in the medium move parallel to the direction that the wave travels along the medium is called
A) a transverse wave.
B) a longitudinal wave.
C) an electromagnetic wave.
D) a seismic wave.
E) a water wave.

17. 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 wavelength?

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.
E) They all have different periods.

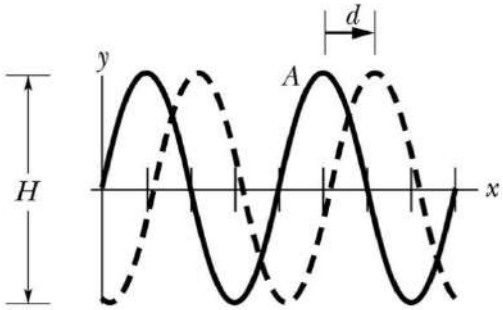
18. A uniform piece of string with a length L = 5.00 m and mass m = 0.0100 kg is held taut by an unknown tension $\boldsymbol{F_T}$ applied at both ends of the string. The string is plucked and a transverse wave is generated. Its wavelength is 0.0350 m and its frequency is 780. Hz. What is the tension $\boldsymbol{F_T}$?

A) 0.674 N
B) 3.83 N
C) 13.2 N
D) 1.49 N
E) 0.0545 N

19. 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?

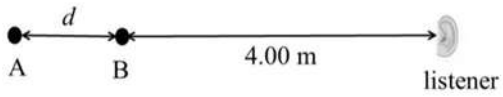
A) The wave is traveling in the +x direction.
B) The wave is traveling in the −x direction.
C) The wave is oscillating but not traveling.
D) The wave is traveling but not oscillating.
E) None of above.

20. A sinusoidal wave moving along a string is shown twice in the figure, as crest A travels in the positive direction of an x axis by distance d = 6.0 cm in 4.0×10^{-3} s. The tick marks along the axis are separated by 10 cm, height H =6.00 mm. If the wave equation is of the form $y(x, t) = y_m \sin(k x - \omega t)$, find the angular frequency, ω.



A) 118 s^{-1}
B) 236 s^{-1}
C) 167 s^{-1}
D) 150 s^{-1}
E) 274 s^{-1}

21. Two small speakers A and B are driven in step at 750. Hz by the same audio oscillator. These speakers both start out 4.00 m from the listener, but speaker A is slowly moved away. See the figure. At what distance d will the sound from the speakers first produce destructive interference at the location of the listener? (The speed of sound in air is 343 m/s.)



A) 0.686 m
B) 0.456 m
C) 0.229 m
D) 0.114 m
E) 0.057 m

22. A string with one fixed end and an open end is observed to form a standing wave with a frequency of 250 Hz in its fundamental mode. It will also form a standing wave at frequency
A) 500 Hz
B) 650 Hz
C) 750 Hz
D) 800 Hz
E) 1000 Hz

23. A pipe of length L in a pipe organ has a closed end and an open end. The pipe is played in its third lowest frequency f = 240 Hz. Using v = 344 m/s for the speed of sound in air, determine L.
A) 2.51 m.
B) 0.872 m.
C) 1.79 m.
D) 0.558 m.
E) 1.08 m.

24. A flute player hears two beats per second when the player compares the player's note to a 523 Hz tuning fork. The player can match the frequency of the tuning fork by pushing in the "tuning joint" to shorten the player's flute slightly. What was the player's initial frequency?
A) 519 Hz
B) 521 Hz
C) 525 Hz
D) 527 Hz
E) 531 Hz

25. A bat emits a sound at a frequency of 3.00×10^4 Hz as it approaches a wall. The bat detects beats such that the frequency of the echo is 900 Hz higher than the frequency the bat is emitting. The speed of sound in air is 340 m/s. The speed of the bat is closest to
A) 20.0 m/s
B) 530 m/s
C) 10.0 m/s
D) 30.0 m/s
E) 5.02 m/s