说明（非常重要）：

1. 本样卷只作为题型和难度的参考，并没有按照各章的内容分布分数。
2. 各题涉及到的内容不是必考点，没有出现的内容也不是不考。
3 选择题有多种来源，计算题主要来自教材，切不可因为某些巧合而误导复习。

I. Multiple choice: In each question, there is only one correct answer. Write your answers in the table. (30 points)

题号	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
答案															

1. The standard of time is based on:
   A. the daily rotation of the Earth
   B. the frequency of light emitted by Cs-133
   C. the yearly revolution of the Earth about the sun
   D. a precision pendulum clock
2. A vector of magnitude 3 CANNOT be added to a vector of magnitude 4 so that the magnitude of the resultant is:
   A. zero B. 1 C. 3 D. 5
3. A particle moves along the x axis from x_i to x_f. Of the following values of the initial and final coordinates, which results in the displacement with the largest magnitude?
   A. $x_i = 4\text{m}, x_f = 6\text{m}$ B. $x_i = -4\text{m}, x_f = -8\text{m}$
   C. $x_i = -4\text{m}, x_f = 2\text{m}$ D. $x_i = -4\text{m}, x_f = 4\text{m}$
4. If you choose a train as the reference frame, Newton's second law is definitely valid when the train is moving
   A. at constant speed. B. at constant velocity.
   C. at positive acceleration. D. at negative acceleration.
5. A particle is doing a uniform circular motion. The relationship among the radius r, the angular speed ω, and the centripetal acceleration a is
   A. $a = \omega^2 r$ B. $a = \omega^2 r/2$ C. $a = \omega r^2$ D. $a = \omega r^2/2$
6. If the net force acting on a body is constant, what can we conclude about its momentum $\vec{P}$?
   A. The magnitude and/or the direction of $\vec{P}$ may change.
   B. The magnitude of $\vec{P}$ remains fixed, but its direction may change.
   C. The direction of $\vec{P}$ remains fixed, but its magnitude may change.
   D. Both the magnitude and the direction of $\vec{P}$ remain fixed.
7. In a system of particles, the total mechanical energy $K+U$ may be changed
   A. only by internal forces. B. only by external forces.
   C. by internal forces and/or by external forces.
   D. neither by internal forces nor by external forces.

8. Two objects are connected by a compressed spring. The combined object is freely falling down. The spring is suddenly released, resulting one object moving up. The center of mass of the two objects will

A. move downward and accelerate downward.

B. move downward and accelerate upward.

C. move upward and accelerate downward.

D. move upward and accelerate upward.

9. A wheel is spinning with nonzero angular acceleration. The ratio of the tangential acceleration of a point on the rim to the tangential acceleration of a point halfway between the center and the rim is:

A. 2 B. 1/2 C. 4 D. 1/4

10. An object is rotating about a fixed axis. The net torque acting on it, its rotational inertia, and its angular acceleration satisfy the equation $\tau = I\alpha$. This equation

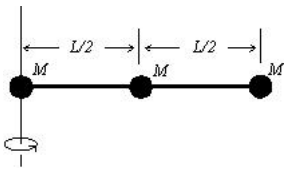
A. is the definition of torque.

B. is the definition of rotational inertia.

C. is the definition of angular acceleration.

D. follows directly from Newton's second law.

11. Three identical objects, each of mass M, are fastened to a massless rod of length L as shown in the figure. The rotational inertia about one end of the rod is



A. $ML^2/4$ B. $ML^2/2$ C. $3ML^2/2$ D. $5ML^2/4$

12. A cylinder is rolling without slipping on a plane from left to right. Which point in the cylinder has the largest speed?

A. The center B. The bottom C. The top D. The right

13. A one-dimensional force $F(x) = kx(l - x)$ acting on a particle moves from $x = 0$ to $x = l$. The work done by the force is

A. $W = kl^3/2$ B. $W = kl^3/3$ C. $W = kl^3/6$ D. $W = 0$

14. A force acting on a particle is conservative if it satisfies the condition that

A. its work is zero when the particle moves through any closed path.

B. its work equals the change in the kinetic energy of the particle.

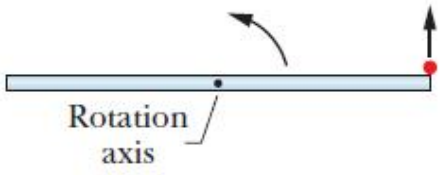
C. it obeys Newton's second law

D. it is not a frictional force.

15. Which of the following force is conservative?

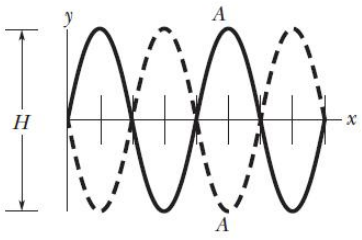
A. $\vec{F} = x\hat{i} + x\hat{j}$ B. $\vec{F} = 2x\hat{i} + y\hat{j}$ C. $\vec{F} = y\hat{i} - x\hat{j}$ D. $\vec{F} = 2y\hat{i} + x\hat{j}$

II（10 分）A thin uniform rod of length L=0.80m and mass M rotating horizontally at angular speed 20 rad/s about an axis through its center. A particle of mass $M/3$ initially attached to one end is ejected from the rod and travels along a path that is perpendicular to the rod. If the particle's speed v_p is 6.0 m/s greater than the speed of the rod end just after ejection, what is the value of v_p?

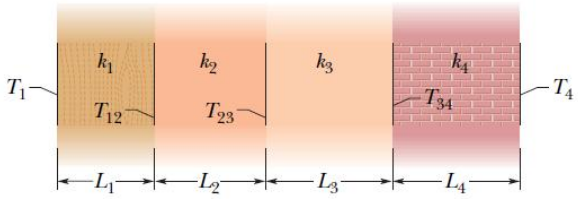


III（10分） A simple harmonic oscillator consists of a block of mass 2.00 kg attached to a spring of spring constant 100 N/m. When t = 1.00 s, the position and velocity of the block are x = 0.129 m and v = 3.415 m/s. (a) What is the amplitude of the oscillations? What were the (b) position and (c) velocity of the block at t = 0 s?

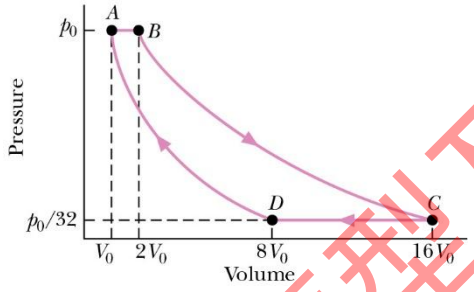
IV（10分）Two sinusoidal waves with the same amplitude and wavelength travel along a string. Their resultant wave is shown twice in the figure, as the antinode A travels from an extreme upward displacement to an extreme downward displacement in 6.0 ms. The tick marks along the axis are separated by 10 cm; height H is 1.80 cm. Let the equation for one of the two waves be of the form $y(x, t) = y_m \sin(kx+\omega t)$. In the equation for the other wave, what are (a) y_m, (b) k, (c) ω, and (d) the sign in front of ω?



V（10分）A wall consisting of four layers, with thermal conductivities k_1 = 0.060 W/mK, k_3 = 0.040 W/m K, and k_4 = 0.12 W/m K. The layer thicknesses are L_1 = 1.5 cm, L_3 = 2.8 cm, and L_4 = 3.5 cm. The known temperatures are T_1 = 30°C, T_{12} = 25°C, and T_4 =10°C. Energy transfer through the wall is steady. (a) What is the rate of heat conduction per unit area? (b) What is interface temperature T_{34}?



VI（15分）An ideal gas (1.0 mol) undergoes a cycle shown in the figure. Processes *BC* and *DA* are adiabatic. (a) Find the value C_p/C_V and the type of the gas molecule (monatomic, diatomic, or polyatomic). (b) Find the energy added to the gas as heat. (c) Find the energy leaving the gas as heat. (d) Find the efficiency of the cycle.



VII（15 分） Assume that the limits of the visible spectrum are chosen as 430 nm and 680 nm in wavelength. Calculate the number of rulings per millimeter of a grating that will spread the first-order spectrum through an angle of 20.0°.