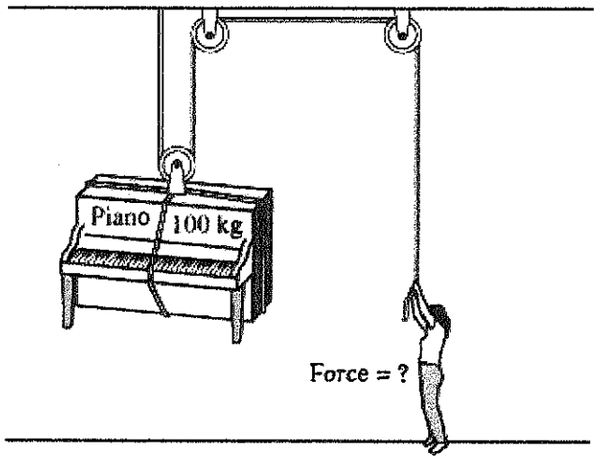
一、Multiple Choice Questions (選擇題) 50% (每題5%)

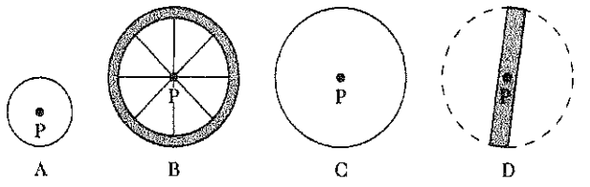
1. A piano mover raises a 100 kg piano at a constant rate using a frictionless pulley system, as shown in Figure below. With roughly what force is the mover pulling down on the rope?



A) 250 N
B) 500 N
C) 1000 N
D) 2000 N
E) Depends on the velocity!

2. A steady horizontal force lasting for 2.10 s gives a 1.25 kg object an acceleration of 3.20 m/s^2 on a frictionless table. What impulse does this force give to the object?
A) 25.7 kg m/s
B) 10.9 kg m/s
C) 8.40 kg m/s
D) 4.00 kg m/s
E) 2.63 kg m/s

3. In Figure below are scale drawings of four objects, each of the same mass and uniform thickness. Which has the greatest moment of inertia when rotated about an axis perpendicular to the plane of the drawing? In each case the axis passes through point P.

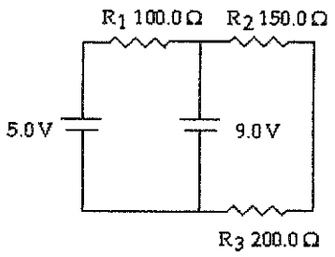


A) A

B) B
C) C
D) D
E) The moment of inertia is the same for all of these objects.

4. What is the efficiency of a Carnot engine operating between a reservoir in which ice and water coexist, and a reservoir in which water and steam coexist? The pressure is constant at 1.0 atmosphere for both.
A) 27%
B) 0.27%
C) 100%
D) 1.0%
E) None of the above answers are correct.

5. What is the current through resistor R_1 in the circuit in Figure below?



A) 0.0089 A
B) 0.031 A
C) 0.14 A
D) 0.040 A
E) None of the above answers are correct.

6. A charged particle moving within a static magnetic field
A) will always experience a magnetic force, regardless of its direction of motion.
B) may experience a magnetic force which will cause its speed to change.
C) may experience a magnetic force, but its speed will not change.
D) None of the above statements are true.

7. The reactance of a capacitor is 7.0 k Ω at a frequency of 0.20 kHz. What is the capacitance?
A) 0.161 μF
B) 4.5 μF
C) 0.71 μF
D) 0.114 μF
E) None of the above answers are correct.

8. A particle has speed 0.95 c and total energy 4.8×10^{-10} J. What is its momentum?
A) 1.5×10^{-18} kg · m/s

B) 2.5×10^{-15} kg · m/s
C) 5.6×10^{-13} kg ·m/s
D) 1.0×10^{-9} kg · m/s
E) None of the above answers are correct.

9. A blue photon
A) has a smaller wavelength than a red photon and travels with the same speed.
B) has a smaller wavelength than a red photon and travels with a greater speed.
C) has a longer wavelength than a red photon and travels with the same speed.
D) has a longer wavelength than a red photon and travels with a greater speed.
E) None of the above statements are correct.

10. How many 3*d* electron states can an atom have?
A) 0
B) 4
C) 6
D) 8
E) 10

二、Questions (問答題) 20%

1. State the law of conservation of angular momentum.(5%)
2. Write down and describe Bernoulli's equation for the flow of an ideal fluid along any tube of flow. (5%)
3. Describe the first law of thermodynamics. (5%)
4. State the Kirchhoff's law (Kirchhoff's junction law and Kirchhoff's loop rule) for the analysis of electrical circuits. (5%)

三、Problems (計算題) 30 %

1. A body of mass 3.0 kg undergoes an elastic collision with another body at rest and continues to move in the original direction but with one-half of its original speed. (a) What is the mass of the other body? (b) What is the speed of the two-body center of mass if the initial speed of the 3.0 kg was 8.0 m/s? (15%)
2. A particle of charge $-q$ is at the origin of x axis. (a) At what location on the axis should a particle of charge $-4q$ be placed so that the net electric field is zero at x = 4.0 mm on the axis? (b) If, instead, a particle of charge $+4q$ is placed at that location, what is the magnitude and direction (relative to the position direction on the x-axis) of the net electric field at x = 4.0 mm? (15%)