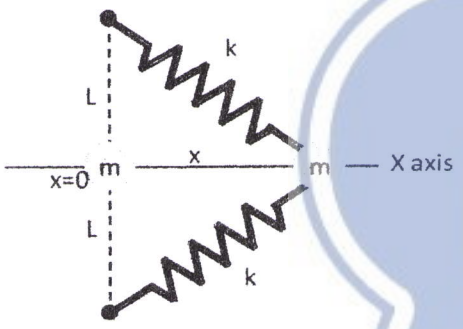
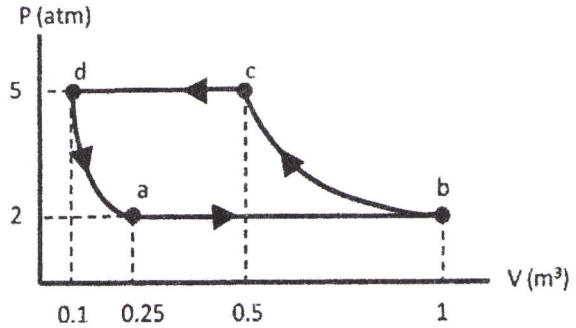
考試科目	普通物理	所別	應用物理研究所 8162,8163	考試時間	2月23日(日)第一節

1. **(18%)** Because of the Earth's rotation, a plumb bob does not hang exactly along a line directed to the center of the Earth. Assume the Earth is spherical and the plumb bob hangs at 30.0° north latitude. (a) Plot the diagram of force on the plumb. Indicate all forces acted on it and its acceleration. (b) Calculate the centripetal acceleration "a_c" of the plumb. Express your answer in the radius of Earth "R", the period of Earth's rotation "T", and gravitational acceleration "g". (c) How much does the plumb bob deviate from a radial line? Express your answer in centripetal acceleration "a_c" and gravitational acceleration "g"

2. **(18%)** A particle of mass m = 1.4 kg is attached between two identical springs on a frictionless, horizontal tabletop. Both springs have spring constant k and are initially unstressed, and the particle is at x = 0. (a) The particle is pulled a distance x along a direction perpendicular to the initial configuration of the springs as shown in Figure. Find the force exerted by the springs on the particle (b) Find the potential energy of the system U(x). (c) Assume L = 2.0 and k = 50.0 N/m. If the particle is pulled 1.0 m to the right and then released, what is its speed when it reaches x = 0?



3. **(16%)** A sample of an ideal gas goes through the process shown in Figure. From a to b, it is isobaric with 100 kJ of energy entering the system by heat; from b to c, the process is isothermal; from c to d, it is isobaric with 200 kJ of energy leaving the system by heat; and from d to a, the process is adiabatic. Determine the difference in internal energy $E_{int,a} - E_{int,d}$.



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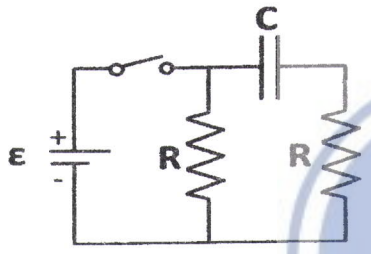
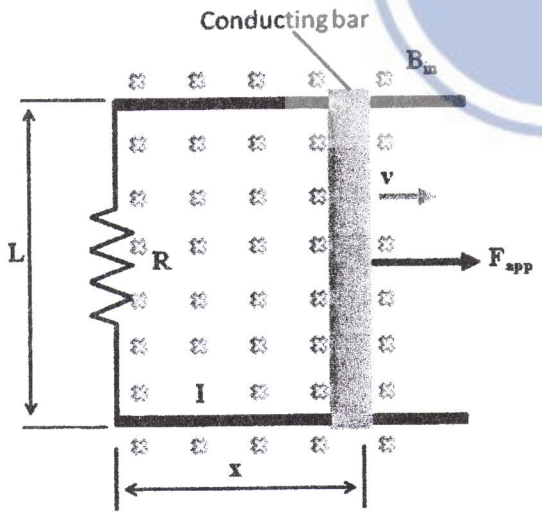
4. **(16%)** (a) Calculate the electric field at a point lying a distance x from the center of a ring with radius R along the central axis perpendicular to the plane of the ring. The ring carries a uniformly distributed charge density λ. (b) Use result from (a), calculate the electrical field at a point lying a distance x from the center of a disk with radius R. The disk has a uniform surface charge density σ.

5. **(16%)** Consider the circuit in the figure and assume the battery has no internal resistance. ε =12 V. R=0.8 MΩ. C=5 μF. (a) Calculate the current in the battery when switch is just closed. (b) Calculate the current in the battery when switch is closed for a long time. (c) Find the constant time of the circuit. (d) According to the time constant, can you explain what "for a long time" means in (b) by specifying the duration when capacitance is fully charged?



6. **(16%)** A conducting bar with length "L" moves through a uniform field "B_{in}". A force F_{app} is applied on the bar and the bar moves at constant velocity "v". Assume moving bar has zero resistance and stationary part has a resistance "R". (a) Find the motional emf and draw the equivalent circuit diagram. (b) Find the current "I" in the circuit. (c) Find the applied force "F_{app}" which makes the bar moves at constant speed. (d) Find the power from the applied force. (Express your answer in terms of B_{in}, v, L and R).



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