Student ID Number: _____

PRELIMINARY EXAMINATION

Department of Physics
University of Florida
Part D, August, 2017, 14:00–17:00

Instructions

1. You may use a calculator and CRC Math tables or equivalent. No other tables or aids are allowed or required. You may **NOT** use programmable calculators to store formulae.

   (a) All of the problems will be graded and will be tabulated to generate a final score. Therefore, you should submit work for all of the problems.

   (b) For convenience in grading please write legibly, use only one side of each sheet of paper, and work different problems on separate sheets of paper. The sheets for each problem will be stapled together but separately from the other two problems.

   (c) Your assigned student **ID Number**, the **Problem Number**, and the **Page Number** should appear in the upper right hand corner of each sheet. Do **NOT** use your name anywhere on the Exam.

   (d) All work must be shown to receive full credit. Work must be clear and unambiguous. Be sure that you hand your completed work to the Proctor.

   (e) Each problem is worth 10 points.

   (f) Following the UF Honor Code, your work on this examination must reflect your own independent effort, and you must not have given, nor received, any unauthorized help or assistance. If you have any questions, ask the Proctor.

University of Florida Honor Code: We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: *"On my honor, I have neither given nor received unauthorized aid in doing this assignment."*

DO NOT OPEN EXAM UNTIL INSTRUCTED

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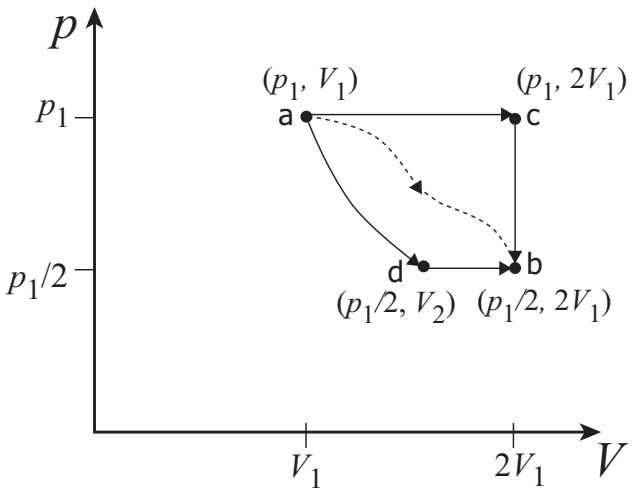
D1. **(Biswas)** A mole of ideal gas undergoes a Joule expansion from point a to b along the irreversible path (dashed line) shown in the figure. The solid lines are reversible processes. The curved solid line from point a to d is an adiabat.



(a) **[2 points]** Show that the change in entropy from point a to c (isobar) is $c_p \ln 2$, where c_p is the molar heat capacity of an ideal gas at constant pressure.

(b) **[2 points]** Show that the change in entropy from point c to b (isochore) is $-c_V \ln 2$, where c_V is the molar heat capacity of an ideal gas at constant volume.

(c) **[1 points]** Find the change in entropy from point a to d (adiabat).

(d) **[2 points]** Find the change in entropy from point d to b (isobar).

(e) **[3 points]** Show explicitly that the change in entropy along the path acb is the same as along path adb.

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D2. **(Mitselmakher)** You fired two one-gram putty-balls at each other, from opposite directions, each with a speed of 10^4 m/s (very fast for putty-balls), and they stick together.

(a) **[3 points]** What is the total mass of the blob after the collision?

(b) **[2 points]** What is the fractional change in the mass (δM/total rest mass)?

(c) **[2 points]** How much energy is represented by this change of the mass?

(d) **[3 points]** If it takes 4.2 J of thermal energy to raise the temperature of 1 kg of putty by 1°C, what is the temperature increase associated with the energy change?

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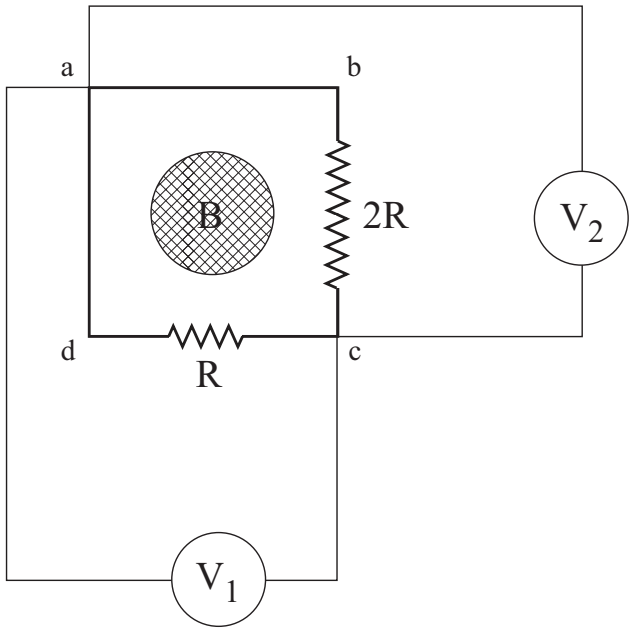
D3. **(Furic)** A circuit with two resistors, with resistance R and $2R$, two voltmeters V_1 and V_2, and a solenoid is constructed as shown in the figure. The solenoid is perpendicular to the circuit and has a cross-sectional area A. The magnetic field B inside the solenoid is uniform, has an RMS (root mean square) magnitude B_0 and oscillates sinusoidally with an angular frequency ! . Give all of your answers in terms of A, B_0, ! and R.



(a) **[2 points]** What is the RMS value of the induced EMF, from the solenoid, about the loop abcd?

(b) **[2 points]** What is the RMS value of the current flowing through the loop abcd?

(c) **[3 points]** What is the RMS value of the potential measured by V_1?

(d) **[3 points]** What is the RMS value of the potential measured by V_2?