UNIVERSITÉ D'OTTAWA
UNIVERSITY OF OTTAWA

FACULTÉ DES SCIENCES
FACULTY OF SCIENCE

PHY 1122

February 16, 2007
Mid-Term Exam

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The answers should be entered carefully on a computer readable sheet using an HB pencil. When the exam time is over, you hand over only the computer sheet and keep this questionnaire for yourself.

1. A balloon is released from a tall building. Its total mass, including the enclosed gas, is 2.00 kg. Its volume is 5.00 m^3. The density of air is 1.3 kg/m^3. What is the magnitude of the initial acceleration of the balloon?

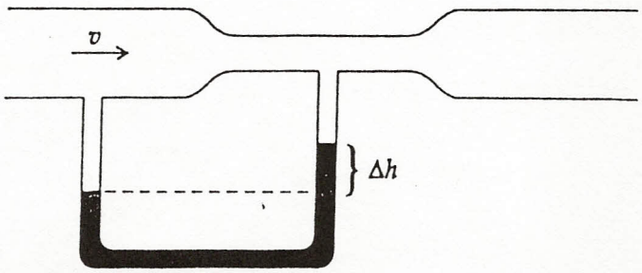
A) zero
B) 9.8 m/s^2
C) 10.9 m/s^2
D) 22.1 m/s^2
E) 43.6 m/s^2

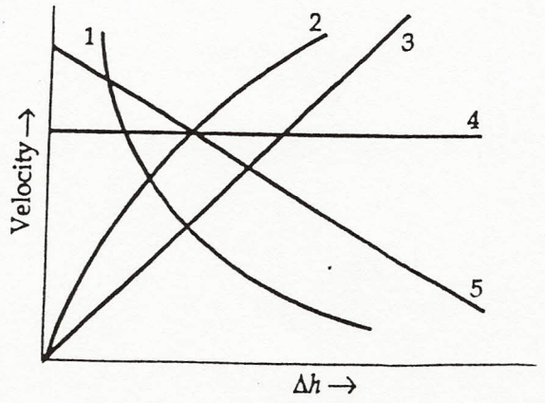
D

2. An incompressible fluid is in streamline flow through a Venturi meter, as shown. In the graph, one of the curves is a calibration curve for the meter, showing the fluid velocity plotted against the gauge reading. Which curve best represents the calibration data?

A) 1
B) 2
C) 3
D) 4
E) 5

B





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3. A long U-tube contains mercury (density = 14×10^3 kg/m^3). When 10 cm of water (density = 1.0×10^3 kg/m^3) is poured into the left arm, the mercury in the right arm rises above its original level by

A) 0.36 cm.
B) 0.72 cm.
C) 14 cm.
D) 35 cm.
E) 70 cm.

A

4. The pressure of an enclosed sample of gas is doubled while the temperature is held constant. The average speed of the molecules hitting the walls of the container

A) increases by a factor 2.
B) remains constant.
C) increases by a factor 4.
D) increases by a factor $\sqrt{2}$.
E) decreases by a factor $\sqrt{2}$.

B

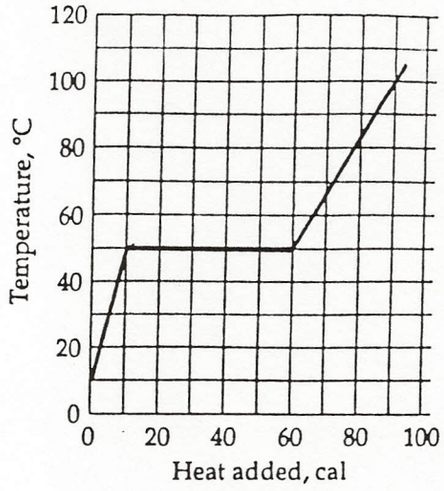
5. You are putting up an external wall measuring 2.0 m by 3.0 m and consisting of a layer of white pine of thickness 1.9 cm and a layer of rock wool. You want to put in enough rock wool so that the thermal conduction rate through the wall does not exceed 120 W during a winter night when the external temperature is 36 K below the indoor temperature. What thickness of rock wool is needed? (The thermal conductivities of the white pine and rock wool are respectively, 0.11 and 0.043 W/m·K).

A) 22 cm
B) 15 cm
C) 7.0 cm
D) 3.5 cm
E) none of the above

C

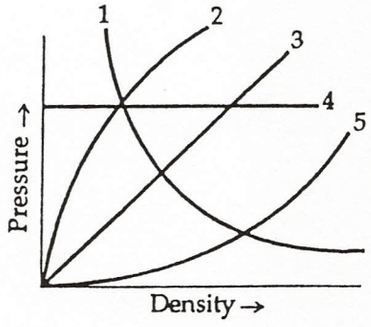
6. The graph shows the temperature of a 1.0-g sample of material as heat is added to it. The material is initially a solid at 10°C. The pressure remains constant and there is no chemical change. The heat of fusion of the material is

A) 10 cal/g.
B) 50 cal/g.
C) 30 cal/g.
D) 90 cal/g.
E) none of the above



7. The curve on the graph of pressure versus density that best represents an isothermal process for a given amount of an ideal gas is

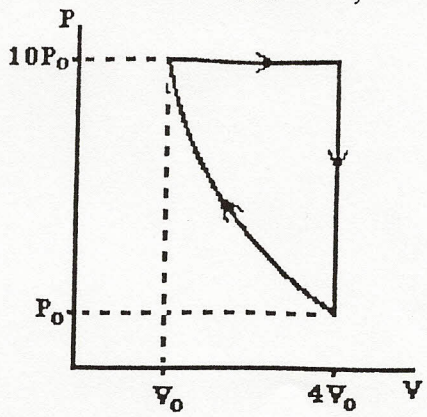
A) 1.
B) 2.
C) 3.
D) 4.
E) 5.



8. A Carnot engine whose high-temperature reservoir is at 400 K has an efficiency of 30.0%. By how much should the temperature of the low-temperature reservoir be changed to increase the efficiency to 40.0%?

A) –10 K
B) 263 C°
C) –20 K
D) 233 C°
E) –40 K

9. An ideal gas with the ratio of the molar specific heat at constant pressure to the molar specific heat at constant volume $\gamma = 1.40$ is carried through the cycle illustrated here. The compression is adiabatic. What is the efficiency of an engine utilizing this cycle?

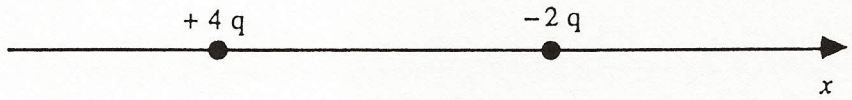


A) 14%
B) 19%
C) 23%
D) 27%
E) 31%

10. On a warm day a pool of water spontaneously ejects heat to the air and freezes. This is a direct violation of

A) the zeroth law of thermodynamics.
B) the first law of thermodynamics.
C) the second law of thermodynamics.
D) the third law of thermodynamics.
E) none of the above

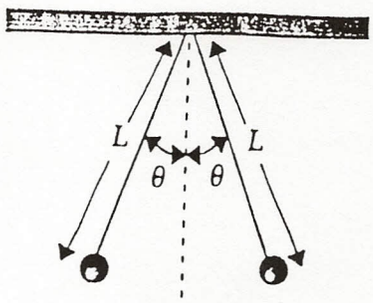
11. At which point (or points) is the electric field zero for the two point charges shown below?



A) The electric field is never zero in the vicinity of these charges.
B) The electric field is zero somewhere on the *x* axis to the left of the + 4q charge.
C) The electric field is zero somewhere on the *x* axis to the right of the –2q charge.
D) The electric field is zero somewhere on the *x* axis between the two charges, but this point is nearer to the –2q charge.
E) The electric field is zero at two points along the *x* axis; one such point is to the right of the –2q charge and the other is to the left of the + 4q charge.

12. Two small spheres, each with mass $m = 3.0$ g and charge q, are suspended from a point by threads of length $L = 0.22$ m. What is the charge on each sphere if the threads make an angle $\theta = 15°$ with the vertical?

A) 0.79 μC
B) 2.9 μC
C) 75 mC
D) 6.3 μC
E) 0.11 μC



13. An electron is released from rest in a uniform electric field. If the electric field is 3.65 kN/C, at the end of 15 ns the electron's velocity will be approximately

A) 9.6×10^6 m/s.
B) 3.9×10^3 m/s.
C) 3.1×10^8 m/s.
D) 5.5×10^3 m/s.
E) 7.4×10^6 m/s.

14. The point P is on the axis of a ring of charge, and all vectors shown lie in the *yz* plane. The negatively charged ring lies in the *xz* plane. The vector that correctly represents the direction of the electric field at this point is

A) $\vec{1}$.
B) $\vec{2}$.
C) $\vec{3}$.
D) $\vec{4}$.
E) $\vec{5}$.