

Name _____ Student ID (three digit, not banner ID) _____

All problems worth 7.7 points each

Some (perhaps) useful information: $1 \text{ atm} = 1.013 \times 10^5 \text{ Pa}$, $1 \text{ Pa} = 1 \text{ N/m}^2$, Ideal Gas Constant = $R = 8.314 \text{ J/(mol} \cdot \text{K)}$
 $1 \text{ kJ} = 10^3 \text{ J}$, $0 \text{ degrees Celsius} = 273 \text{ K}$

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) The temperature of an ideal gas in a sealed 0.40 m^3 container is reduced from 380 K to 270 K . The final pressure of the gas is 30 kPa . The molar heat capacity at constant volume of the gas is $28.0 \text{ J/mol} \cdot \text{K}$. The heat absorbed by the gas, in kJ , is closest to: 1) _____
 A) 16 **B) -16** C) 21 D) -21 E) zero

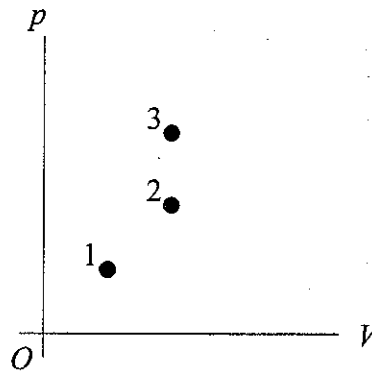
- 2) An ice cube at 0°C is placed in a very large bathtub filled with water at 30°C and allowed to melt, causing no appreciable change in the temperature of the bath water. Which one of the following statements is true? 2) _____
 A) The entropy of the water does not change because its temperature did not change.
B) The entropy of the system (ice plus water) increases because the process is irreversible.
 C) The net entropy change of the system (ice plus water) is zero because no heat was added to the system.
 D) The entropy lost by the ice cube is equal to the entropy gained by the water.
 E) The entropy gained by the ice cube is equal to the entropy lost by the water.

- 3) You want to design an ideal Carnot heat engine that wastes only 35.0% of the heat that goes into it. The lowest cold-reservoir temperature available to you is $+15.0^\circ\text{C}$. The temperature of the hot reservoir should be closest to: 3) _____
A) 550°C B) 43°C C) 823°C D) 170°C E) 443°C

4) _____ 4) _____

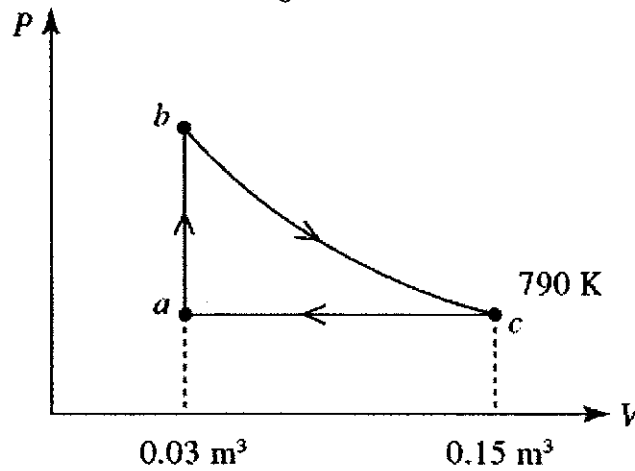
This pV -diagram shows three possible states of a certain amount of an ideal gas.

Which state is at the *highest* temperature?



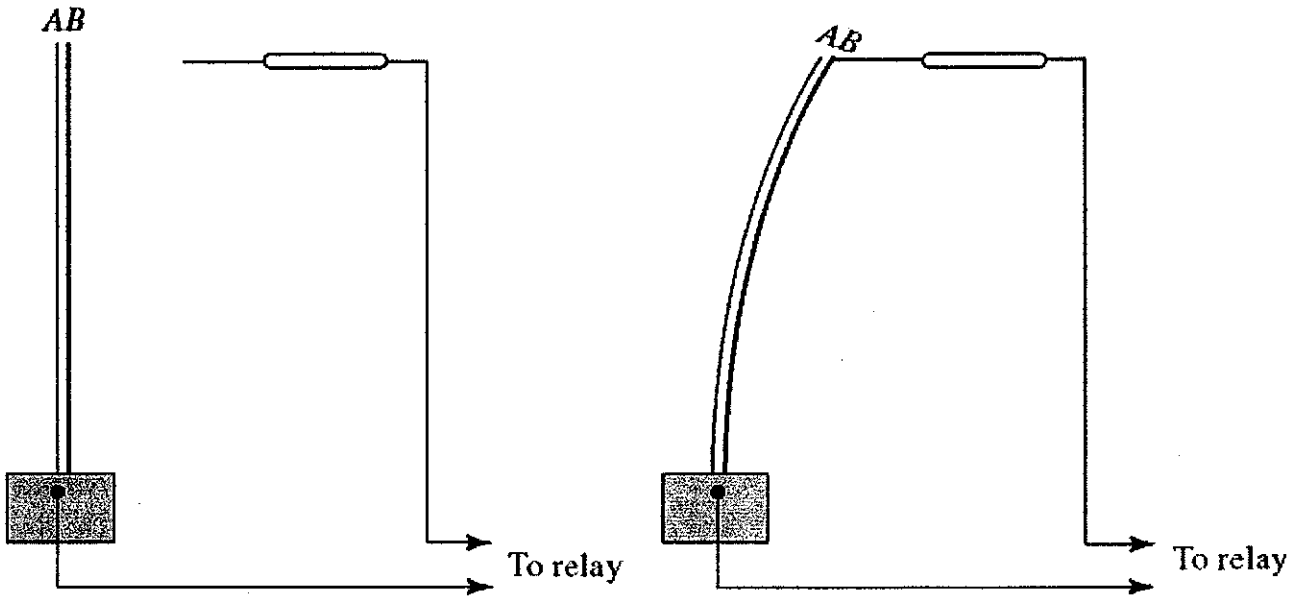
- A. state #1
 B. state #2
C. state #3
 D. Two of these are tied for highest temperature.
 E. All three of these are at the same temperature.

Figure 20.2b



- 5) A heat engine takes 6.0 moles of an ideal gas through the reversible cycle $abca$, on the pV diagram, as shown. The path bc is an isothermal process. The temperature at c is 790 K, and the volumes at a and c are 0.03 m^3 and 0.15 m^3 , respectively. The molar heat capacity of the gas, at constant volume, is $26 \text{ J/mol} \cdot \text{K}$. In Fig. 20.2b, for the path bc , the work done by the gas, in kJ, is closest to: 5) _____
- A) 160 B) 63 C) -160 D) -63 E) zero
- 6) An ideal gas is held in a container of volume V at pressure P . The root mean square speed of a gas molecule under these conditions is v . If now the volume and pressure are changed to $2V$ and $2P$, the root mean square speed of a molecule will be: 6) _____
- A) $1/2 v$ B) v C) $4v$ D) $v/4$ E) $2v$

Figure 17.2

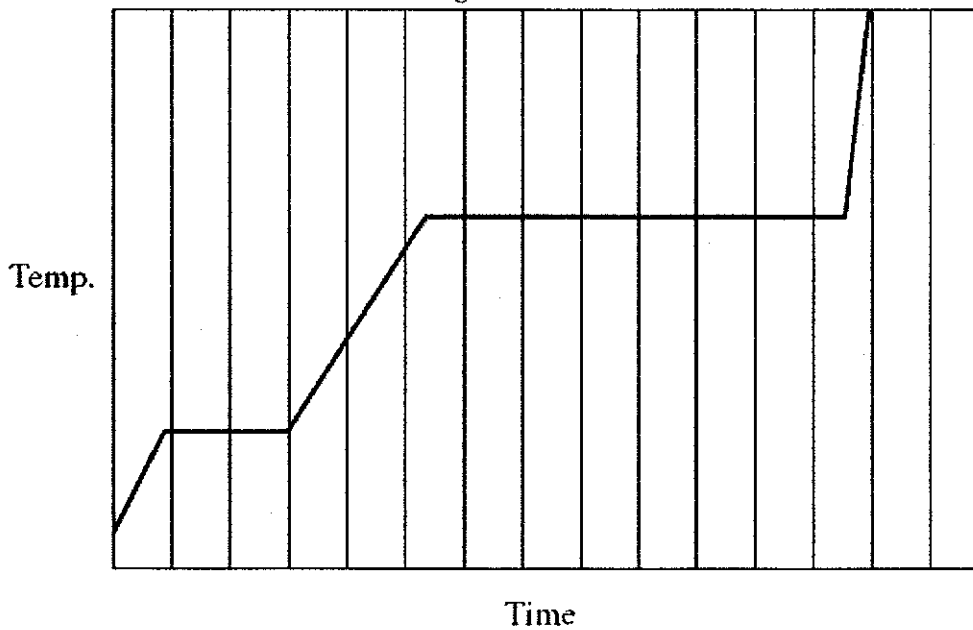


Shown here is a device that can be used to turn a furnace on or off, depending on the temperature sensed by the device.

- 7) In Fig. 17.2, the principle underlying the operation of this device is that
- A) heat always flows from hot to cold, never from cold to hot.
 - B) different metals have different heat capacities.
 - C) different metals have different thermal expansion coefficients.
 - D) different metals have different thermal conductivities.
 - E) different metals have different latent heats.

7) _____

Figure 17.3



- 8) In Fig. 17.3, heat is added to a pure substance in a closed container at a constant rate. A graph of the temperature of the substance as a function of time is shown here. If L_f = latent heat of fusion and L_v = latent heat of vaporization, what is the value of the ratio L_v/L_f for this substance?

8) _____

- A) 3.5
- B) 7.2
- C) 5.0
- D) 4.5
- E) 1.5

- 9) Which of the following is a FALSE statement? 9) _____
- A) The difference in entropy between two states of a system is independent of the path between the two states.
 - B) The entropy of an isolated system is conserved, i.e., constant.
 - C) Entropy is a quantitative measure of disorder.
 - D) The total entropy change in one cycle of a Carnot engine is zero.
 - E) Entropy can be measured in units of J/K.
- 10) A 3.2 L ($1000\text{L} = 1\text{ m}^3$) volume of neon gas (monatomic) is at a pressure of 3.3 atmospheres and a temperature of 330 K. The atomic mass of neon is 20.2 g/mol. The mass of the neon gas, in SI units, is closest to: 10) _____
- A) 7.8
 - B) 7.8×10^2
 - C) 3.8
 - D) 4.6×10^{-3}
 - E) 7.8×10^{-3}
- 11) A 5.0-liter gas tank holds 2.0 moles of helium (monatomic) and 0.6 moles of oxygen (diatomic), at a temperature of 390 K. The atomic masses of helium and oxygen are 4.0 g/mol and 16.0 g/mol, respectively. The ratio of the rms speed of helium to that of oxygen, is closest to: 11) _____
- A) 1.4
 - B) 2.0
 - C) 5.6
 - D) 4.0
 - E) 2.8
- 12) A cylindrical bar that connects hot and cold reservoirs conducts heat at a rate of 10.0 J/s. If all of its linear dimensions (diameter and length) are reduced by half, the rate at which it will now conduct heat between the same reservoirs is closest to: 12) _____
- A) 2.50 J/s
 - B) 80.0 J/s
 - C) 5.00 J/s
 - D) 20.0 J/s
 - E) 1.25 J/s
- 13) A monatomic ideal gas ($C_V = 3/2 R$) undergoes an isothermal expansion at 300 K, as the volume increased from 0.09 m^3 to 0.36 m^3 . The final pressure is 100 kPa. The change in the internal energy of the gas, in kJ, is closest to: 13) _____
- A) zero
 - B) 50
 - C) -25
 - D) 25
 - E) -50