

Physics 161 Fall 2010 Exam 2

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Closed book closed notes calculators OK.

Temperatures in Kelvin, heats / energies are in J, entropies in J/K

A monatomic ideal gas is taken around the reversible cycle shown.

One segment is isothermal; one is adiabatic; one is isochoric.

Fill out the table below to help you answer the questions following.

| | A | B | C |
|---|----------------------|-----|---|
| P | 900 N/m ² | 300 | |
| V | 2 m ³ | | |
| T | 900 K | | |

1&2] What is the volume of the gas at B (in m³)? x 10

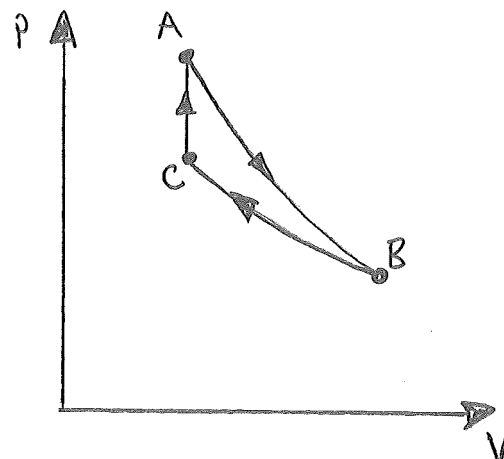
3&4] What is the work done *on* the gas on path BC (in J)? x 10

5&6] What is the heat added to the gas on path CA (in J)? x 10

7&8] What is the work done *by* the gas on path AB (in J)? x 10

9] This is an (A) engine or (B) refrigerator.

10&11] What is the efficiency, in %? x 10%



$$pV = nRT$$

$$pV^\gamma = \text{constant} \quad (Q=0)$$

$$Q = nC_v\Delta T \quad (\text{constant } V)$$

$$\gamma = C_p/C_v$$

$$C_p = C_v + R$$

$$C_v = \frac{3}{2}R \quad (\text{monatomic ideal gas})$$

$$\Delta U = Q - W$$

$$R = 8.3 \text{ J/molK}$$

$$dS = \frac{dQ}{T}$$

$$\vec{F}_{el} = k \frac{q_1 q_2}{r^2} \hat{r} \quad k = 9 \times 10^9 \frac{\text{Nm}^2}{\text{C}^2}$$

Substance P melts at 300K. The latent heat of fusion is 280 J/g.

32 g of substance P is immersed in a very large oil bath at 450K.

12&13] What is the increase in entropy (J/K) of substance P when it has melted, but is still at 300K?

14&15] What is the decrease in entropy in the oil bath? You may assume that the change in temperature of the oil bath is negligible.

16] This process is thermodynamically

A] reversible

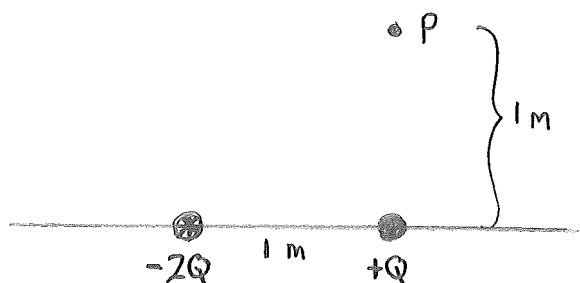
B] irreversible

C] cannot determine

17] You have two lightweight metal spheres, each hanging from an insulating nylon thread. One sphere has negative charge, the other is neutral. As you bring the spheres together:

- a) there is no interaction
- b) they repel weakly at first, and after contact repel more strongly
- c) they repel strongly at first, and after contact repel more weakly
- d) they attract weakly at first, and after contact attract more strongly
- e) they attract strongly at first, and after contact attract more weakly
- f) they repel at first, but attract after contact
- g) they attract at first, but repel after contact

18&19] The electric force on a test charge P caused by point charge +Q alone is 40 N. What is the magnitude of the total electric force on P (in N) when -2Q is added at the point shown?



20] If P is a positive test charge, the total force is in what direction? (or choose (j), the total electric force is zero.)

