**Thermodynamics Worksheet #2: An ideal gas in a Carnot cycle**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | Pa | m3 | J/K | 300 K |
|  |  |  | J/K | 1800 K |
|  |  |  | J/K | 1800 K |
|  |  |  | J/K | 300 K |

P

V

1 atm

1 liter

*a*

*c*

*b*

*d*

300 K

1800 K

(not drawn to scale)

As in the previous worksheet, we start with a sample of diatomic N2 gas at pressure N/m2 (about 1 atm), volume liter, and temperature K. From before, this gives J/K, or moles. As before, we heat the gas to a maximum temperature of 1800 K, but here we do so in one step, a single adiabatic compression.

1. Recalling that is constant for an adiabatic process, where , what is the final volume ? (Answer: m3.)

2. What are , , and ? Go ahead and start filling out the table on the next page if you like. Also, the table at the top of this page may help you keep your thoughts organized.

3. In the process , the gas is expanded isothermally to a new volume, m3. Calculate , , and for this process. (This particular value for makes the numbers in the table turn out pretty. You’ll see.)

4. Now the gas is expanded adiabatically back to K. Find , and also find , , and .

5. Finally, the gas is compressed isothermally back to . Find , , and .

6. If you haven’t done so already, complete the following table:

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
| NET: |  |  |  |

7. Compare the table on page 2 of this worksheet with the table on the previous thermodynamics worksheet, for a rectangular cycle.

a) What is the Net work done by the gas in each case?

b) What is the total heat put into the gas from the hot reservoir?

c) What is the total heat dumped into the cold reservoir in each process?

d) Which heat engine is more efficient? That is, which heat engine does the most work per ton of coal burned?