

Calculating the Efficiency of a Heat Engine

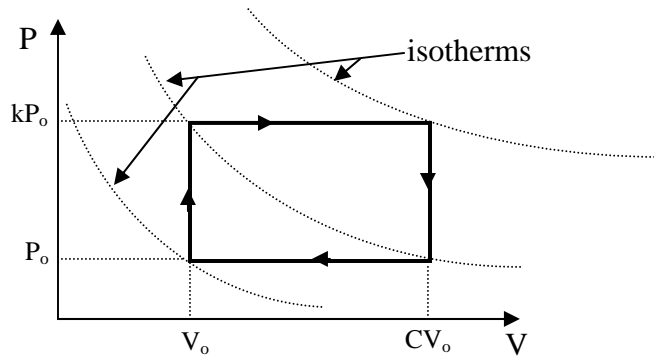
- Purpose:**
1. To gain experience at doing efficiency calculations
 2. To gain experience at using an electronic spreadsheet

Equipment: Windows based computer with Excel software installed

Introduction: The efficiency, e , of a heat engine operating over a closed cycle is defined to be

$$e = W/Q_H$$

where W is the net work done per cycle and Q_H represents the heat input per cycle.



- Procedure:**
1. Using the PV diagram shown find the efficiency of a heat engine operating over the rectangular cycle shown in the PV diagram. In your derivation you can treat the gas as monatomic and ideal. Your result should be in terms of the constants k and C (see the diagram). Carefully, show all steps in your work.
 2. Using the example provided, set up a spreadsheet that does the calculations for efficiency as a function of the constant C . Set up a special cell that allows the user of your spreadsheet to choose the value for k .
 3. On your spreadsheet, create a graph of efficiency vs C to show the dependence of e on C (called the compression ratio).

Sample Spreadsheet

Thermodynamic efficiency for a heat engine using a rectangular PV cycle

compression ratio (c)	efficiency (e)
1	0
2	0.23376623
3	0.28346457
4	0.30508475
5	0.31718062
6	0.32490975
7	0.33027523
8	0.33421751
9	0.33723653
10	0.33962264
11	0.34155598
12	0.34315425
13	0.34449761
14	0.34564254
15	0.34662999
16	0.34749035
17	0.34824667
18	0.34891676
19	0.34951456
20	0.35005118
21	0.35053554
22	0.35097493
23	0.35137533
24	0.35174172
25	0.35207824
26	0.35238841
27	0.35267521
28	0.35294118
29	0.35318851
30	0.35341909
31	0.35363458
32	0.3538364
33	0.35402581
34	0.35420394
35	0.35437174

k = 10

