

Name_____

Date_____

PHYSICS 214 HOMEWORK FOR LAB 11: HEAT ENGINES

(Due at the beginning of Lab 12)

1. Fig. CP21.74 on p. 599 shows a typical cycle for one cylinder of a typical Diesel engine with a displacement $V_{\max}-V_{\min}$ of 1000 cm^3 and a compression ratio $V_{\max}/V_{\min}=21$. The engine takes in air at 25°C and 1 atm pressure. At point 2 the fuel is injected. The combustion of the fuel provides 1000 J of heat energy per cycle.

a) Describe in words what each step of the cycle represents (what type of process; expansion/compression):

1→2:

2→3:

3→4:

4→1:

b) Find p , V , and T at each of the four corners of the cycle. Show your work and summarize your results in the table. Keep a few extra figures to avoid rounding error in the next question.

	$p \text{ (atm)}$	$V \text{ (cm}^3\text{)}$	$T \text{ (K)}$
1	1	1050	298
2		50	
3			
4		1050	

c) Calculate the work done by the cylinder during each part of the cycle, and use these to find the net work done by the engine in one cycle, W_{out} .

1→2

2→3

3→4

4→1

W_{out}

d) Calculate the power output in hp (1 hp=746 W) of an 8-cylinder Diesel engine that's running at 2400 rpm (each cylinder fires once during a single revolution).

e) Find the thermal efficiency of the engine and compare it to the maximum possible (Carnot) efficiency between the maximum and minimum temperatures in the cycle.