

Name of the Student: _____

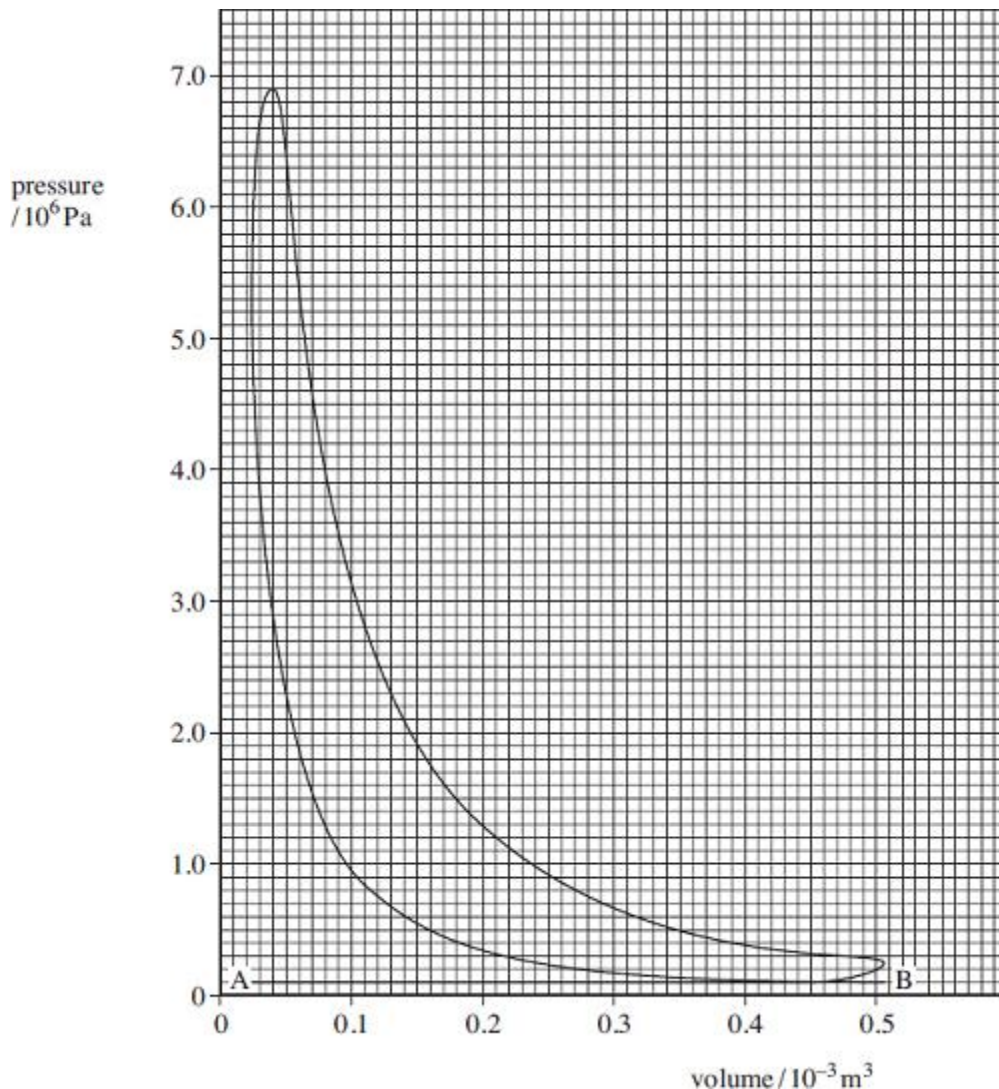
Max. Marks : 20 Marks

Time : 20 Minutes

Q1.

A four-stroke diesel engine with four cylinders is running at constant speed on a test bed. An indicator diagram for **one cylinder** is shown in the figure below and other test data are given below:

measured output power of engine (brake power)	= 55.0 kW
fuel used in 100 seconds	= 0.376 litre
calorific value of fuel	= 38.6 MJ litre ⁻¹
engine speed	= 4100 rev min ⁻¹



- (a) (i) Determine the indicated power of the engine, assuming all cylinders give the same power.

answer = _____ kW (4)

(ii) Calculate the overall efficiency of the engine.

answer = _____ (3)

(b) Account for the difference between the indicated power and brake power.

(1)

(c) What is represented by the line AB on the figure above?

(1)

(Total 9 marks)

Q2.

In an ideal 'hot air' engine, a fixed mass of air is continuously taken through the following four processes:

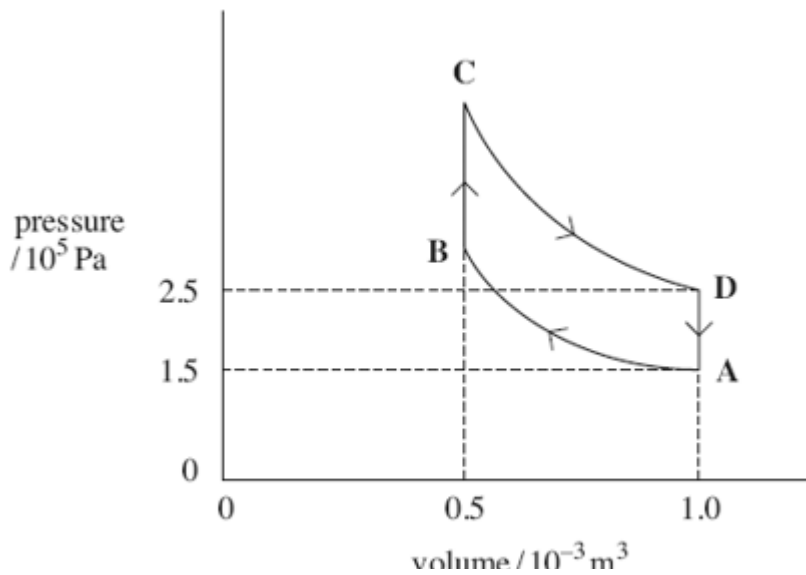
A → B isothermal compression at a temperature of 300 K. The work done on the air is 104 J.

B → C heating at constant volume.

C → D isothermal expansion. The work done by the expanding air is 173 J.

D → A cooling at constant volume.

The cycle is shown in the figure below.



- (a) (i) Show that the temperature of the air at point D is 500 K.

(2)

- (ii) Apply the first law of thermodynamics to calculate the energy supplied by heat transfer in process $C \rightarrow D$.

answer = _____ J

(2)

- (b) The engine contains a device called a regenerator which stores **all** the energy rejected by cooling in process $D \rightarrow A$ and gives up **all** this energy to the air again in process $B \rightarrow C$. This means that energy must be supplied to the air by heat transfer from an external source **only** in process $C \rightarrow D$.

- (i) Calculate the net work done during the cycle.

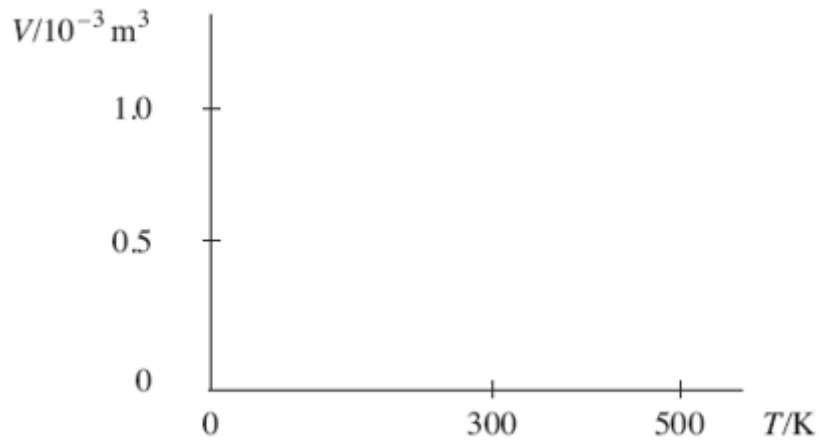
answer = _____ J

(1)

- (ii) Show that the efficiency of the cycle is the same as the maximum possible efficiency of any heat engine operating between the same highest and lowest temperatures in the cycle.

(2)

- (c) On the axes below, sketch the cycle on a graph of volume V against temperature T . Label the points A, B, C and D.



(2)

- (d) Several inventors have tried to build an engine that works on this cycle. Give **two** reasons why they have been unsuccessful.

(2)

(Total 11 marks)