



Prifysgol Cymru ·
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Examination Answer Books

12 Pages

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

Complete, fold and seal
(see note 2 below)

SURNAME: PLATT

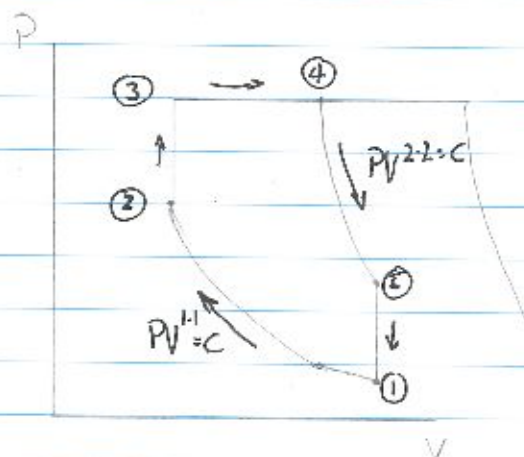
FORENAME(S): THOMAS

1	Student Number	205135
2	Title of Examination Paper	THERMOFLUIDS 1
3	Module Code	SGDM4004
4	Date and Time of Examination	16/01/20 0930
5	Examination Venue	
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
2	17
3	11
4	21
Total	49/75

(Gweler yr ochr arall am y fersiwn Cymraeg)

2 a)



$$\textcircled{1} P_1 = 1 \text{ bar}$$

$$V_1 = 0.65 \text{ m}^3$$

$$\textcircled{2} P_2 = 5 \text{ bar}$$

$$V_2 = 0.15 \text{ m}^3$$

$$\textcircled{3} P_3 = 8 \text{ bar}$$

$$V_3 = V_2 = 0.15 \text{ m}^3$$

$$\textcircled{4} P_4 = 8 \text{ bar}$$

$$V_4 = 0.383 \text{ m}^3$$

$$\textcircled{5} P_5 = 2.5 \text{ bar}$$

$$V_5 = 0.65 \text{ m}^3$$

$$P_2 V_2^{1.1} = P_1 V_1^{1.1}$$

$$5 \times 10^5 \times 0.15^{1.1} = 1 \times 10^5 \times V_2^{1.1}$$

$$62259.37 = 5 \times 10^5 \times V_2^{1.1}$$

$$\frac{62259.37}{5 \times 10^5} = V_2^{1.1}$$

$$0.1245 = V_2^{1.1}$$

$$V_2 = \sqrt[1.1]{0.1245}$$

$$V_2 = 0.15 \text{ m}^3$$

$$P_3 V_3^{2.2} = P_4 V_4^{2.2}$$

$$8 \times 10^5 \times 0.15^{2.2} = 8 \times 10^5 \times V_4^{2.2}$$

$$P_5 V_5^{2.2} = P_4 V_4^{2.2}$$

$$2.5 \times 10^5 \times 0.65^{2.2} = 8 \times 10^5 \times V_4^{2.2}$$

$$96905.72 = 8 \times 10^5 \times V_4^{2.2}$$

$$\frac{96905.72}{8 \times 10^5} = V_4^{2.2} = V_4^{\frac{2.2}{2.2-1}} = \sqrt[0.121]{0.121}$$

$$= 0.383 \text{ m}^3$$

$$W_{D1-2} = \frac{P_1 V_1 - P_2 V_2}{n-1}$$

$$= \frac{1 \times 10^5 \times 0.65 - 5 \times 10^5 \times 0.15}{1.1-1}$$

$$= \frac{65000 - 75000}{0.1}$$

$$= \frac{-10000}{0.1}$$

$$= -100000$$

$$W_{D2-3} = 0$$

$$W_{D3-4} = P(V_4 - V_3)$$

$$= 8 \times 10^5 (0.383 - 0.15)$$

$$= 186400$$

$$W_{D4-5} = \frac{P_4 V_4 - P_5 V_5}{n-1} = \frac{8 \times 10^5 \times 0.383 - 2.5 \times 10^5 \times 0.65}{2.2-1}$$

$$= \frac{143900}{1.1}$$

$$= 130818.25$$

Question No.

$$WD_{TOTAL} = -100 \times 10^3 + 0 + 186.4 \times 10^3 + 130.8 \times 10^3$$
$$= 217200 \text{ J}$$

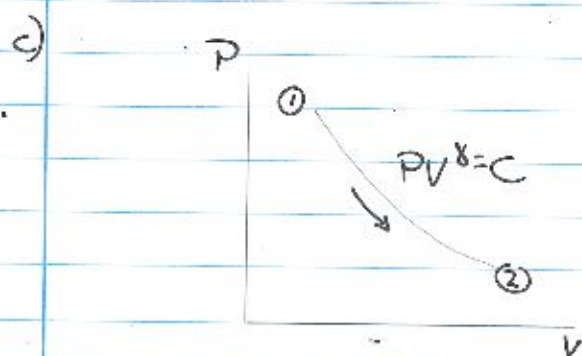
b) The Positive WD_{TOTAL} indicates work is being done by the system

(2)

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Q4 a) A perfect gas obeys the thermodynamic laws perfectly.
The specific heats are the temperature at a specific pressure or volume.

b) An open system is where energy flows into and out of a system ie a nozzle.
A closed system is where conditions change through a series of values but return to the starting conditions like a piston.



$$\gamma = \frac{C_p}{C_v} = \frac{1.075}{0.78} = 1.378 \approx 1.4$$

$$R = C_p - C_v = 1.075 - 0.78 = 0.295 = 295$$

① $P_1 = 10 \text{ bar}$

$V_1 = 0.25 \text{ m}^3$

$T_1 = 150^\circ\text{C} = 423^\circ\text{K}$

i) $P_1 V_1^\gamma = P_2 V_2^\gamma$
 $10 \times 10^5 \times 0.25^{1.4} = P_2 \times 0.85^{1.4}$

$143587.2944 = P_2 \times 0.797$

$P_2 = \frac{143587.2944}{0.797}$

$= 180159.7169 \text{ N}$

$= 1.8 \text{ bar}$

② $P_2 = 1.8 \text{ bar}$

$V_2 = 0.85 \text{ m}^3$

$T_2 =$

ii) $\frac{T_1}{T_2} = \left(\frac{P_1}{P_2}\right)^{\frac{\gamma-1}{\gamma}}$

$\frac{423}{T_2} = \left(\frac{10 \times 10^5}{1.8 \times 10^5}\right)^{\frac{1.4-1}{1.4}}$
 $= 5.56^{0.286}$

$\frac{423}{T_2} = 1.633$

$T_2 = \frac{423}{1.633} = 259^\circ\text{K}$

iii) $W = \frac{P_1 V_1 - P_2 V_2}{\gamma - 1}$

$= \frac{10 \times 10^5 \times 0.25 - 1.8 \times 10^5 \times 0.85}{1.4 - 1}$

$= \frac{250000 - 153000}{0.4}$

$= \frac{97000}{0.4} = 242500 \text{ J}$

iv) $PV = mRT$

$m = \frac{PV}{RT} = \frac{10 \times 10^5 \times 0.25}{295 \times 423} = \frac{250000}{124785} = 2 \text{ kg}$

(1)

(5)

(2)

(3)

(3)

(4)

12/21

- 3 a) The sum of the energy into a system must equal the energy out of a system

$$\sum Q = \sum W$$

(2)

- b) An adiabatic process is such that the value of δ means heat transfer (Q) is effectively 0

(1)

- ii) Enthalpy, h , is the total energy in a system

(1/2)

- iii) An isothermal process has a constant temperature

(1)

- iv) Absolute temperature is temperature measured on the kelvin, $^{\circ}\text{K}$ scale.

(1/2)

- c) $P_1 = 7 \text{ bar}$ $PV^{1.25} = \text{const}$

$$T_1 = 200^{\circ}\text{C} = 473 \text{ K}$$

$$P_2 = 1 \text{ bar}$$

$$T_2 =$$

$$\frac{T_1}{T_2} = \left(\frac{P_1}{P_2} \right)^{\frac{1.25-1}{1.25}}$$

$$\frac{473}{T_2} = \left(\frac{7 \times 10^5}{1 \times 10^5} \right)^{\frac{1.25-1}{1.25}}$$

$$= 7^{0.2}$$

$$\frac{473}{T_2} = 1.48$$

$$T_2 = \frac{473}{1.48} = 319.6 \text{ K}$$

(6)

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