



Complete, fold and seal
(see note 2 below)

FORENAME(S): KARL
ANTHONY.

12 Pages

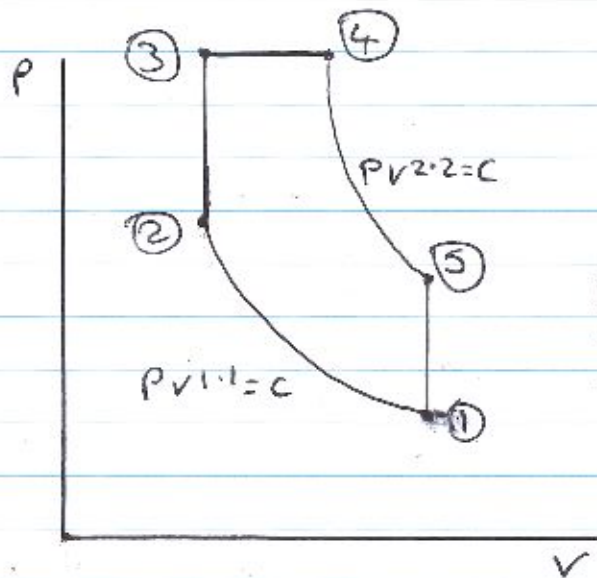
Instructions to Candidates

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.**

1	Student Number	19903
2	Title of Examination Paper	
3	Module Code	SGDM4004
4	Date and Time of Examination	
5	Examination Venue	
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
1	22
2	25
4	17
Total	64/75

85%

2
a)

$$\begin{aligned}
 P_1 &= 1 \times 10^5 \text{ N/m}^2 \\
 V_1 &= 0.65 \text{ m}^3 \\
 P_2 &= 5 \times 10^5 \text{ N/m}^2 \\
 P_3 &= 8 \times 10^5 \text{ N/m}^2 \\
 P_4 &= 8 \times 10^5 \text{ N/m}^2 \\
 P_5 &= 2.5 \times 10^5 \text{ N/m}^2 \\
 V_5 &= 0.65 \text{ m}^3
 \end{aligned}$$

$$WD_{1-2} = \frac{P_1 V_1 - P_2 V_2}{n-1} \quad V_2 = ?$$

$$P_1 V_1^n = P_2 V_2^n$$

$$1 \times 10^5 \times (0.65)^{1.1} = 5 \times 10^5 \times (V_2)^{1.1}$$

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

$$V_2^{1.1} = \frac{62259.37}{5 \times 10^5} = 0.125$$

$$V_2 = \sqrt[1.1]{0.125}$$

$$\begin{aligned}
 V_2 &= 0.15 \text{ m}^3 \\
 V_3 &= 0.15 \text{ m}^3
 \end{aligned}$$

$$WD_{1-2} = \frac{(1 \times 10^5 \times 0.65) - (5 \times 10^5 \times 0.15)}{1.1 - 1}$$

$$WD_{1-2} = -1000000 \text{ J}$$

$$WD_{2-3} = 0 \text{ J}$$

~~$$WD_{3-4} = P_3 V_3 - P_4 V_4$$~~

$$WD_{3-4} = P(V_4 - V_3) \quad V_4 = ?$$

~~WD~~

$$P_4 V_4^n = P_5 V_5^n$$

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

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

$$V_4^{2.2} = \frac{96905.72}{8 \times 10^5} \quad V_4^{2.2} = 0.12$$

$$V_4 = \sqrt[2.2]{0.12}$$

$$\boxed{V_4 = 0.38 \text{ m}^3} \quad \checkmark$$

$$WD_{3-4} = 8 \times 10^5 (0.38 - 0.15)$$

$$\boxed{WD_{3-4} = 184000 \text{ J}} \quad \checkmark$$

(3)

$$WD_{4-5} = \frac{P_4 V_4 - P_5 V_5}{n-1}$$

$$WD_{4-5} = \frac{(8 \times 10^5 \times 0.38) - (2.5 \times 10^5 \times 0.65)}{2.2 - 1}$$

$$\boxed{WD_{4-5} = 117916.6 \text{ J}} \quad \checkmark$$

(3)

$$\boxed{WD_{5-1} = 0 \text{ J}}$$

(3)

$$NET \text{ WD} = -100000 + 0 + 184000 + 117916.6 + 0$$

$$\boxed{NET \text{ WD} = 201916.6 \text{ J}}$$

2b) THE WORK IS DONE BY THE SYSTEM AS IT IS A POSITIVE NUMBER AND POSITIVE ENERGY PUSHES OUT OF THE SYSTEM.

5
25

Q3) a) THE FIRST LAW OF THERMODYNAMICS STATES THAT ENERGY MOVING WITHIN A SYSTEM CAN'T DISAPPEAR OR BE CREATED BUT IT CAN CHANGE FORM, SUCH AS PRESSURE, KINETIC & POTENTIAL ENERGY

b) (i) ADIABATIC PROCESS IS A PROCESS WHERE THERE IS NO HEAT INVOLVED.

(ii) ENTHALPY IS THE TOTAL INTERNAL ENERGY WITHIN A SYSTEM AND IS REPRESENTED BY $U + PV$ IN THE ~~SEE~~ STEADY FLOW ENERGY EQUATION.

(iii) AN ISOTHERMAL PROCESS IS WHEN HEAT IS CONSTANT WHERE $PV = C$.

(iv) ABSOLUTE PRESSURE IS GAGE PRESSURE (ρgh) AND ATMOSPHERIC PRESSURE ARE ADDED TOGETHER.

c)



$$P_1 = 7 \times 10^5 \text{ N/m}^2$$

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

$$P_2 = 1 \times 10^5 \text{ N/m}^2$$

$$C_2 = ?$$

$$PV^{1.25} = C$$

$$C_P = 1005 \text{ J/kgK} \quad C_V = 715 \text{ J/kgK}$$

$$h_1 = C_P T_1 = 1005 \times 473 = 475365 \text{ J/kg}$$

$$h_2 = C_P T_2 \quad T_2 = ?$$

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

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

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

$$T_2 = \frac{473}{1.48} \quad T_2 = 320^\circ \text{K}$$

$$h_2 = 1005 \times 320 = 321600 \text{ J/kg}$$

$$h_1 = h_2 + \frac{c_2^2}{2}$$

$$h_1 - h_2 = \frac{c_2^2}{2}$$

$$475365 - 321600 = \frac{c_2^2}{2}$$

$$153765 = \frac{c_2^2}{2}$$

$$153765 \times 2 = c_2^2$$

$$307530 = c_2^2$$

$$c_2 = \sqrt{307530}$$

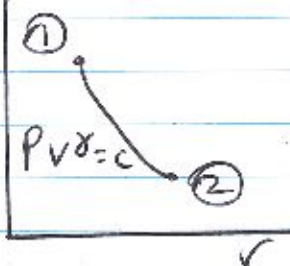
$$c_2 = 555 \text{ m/s}$$

P.T.O.

Q4) a) A PERFECT GAS ABIDES BY THE GAS LAWS PERFECTLY AND THE SPECIFIC HEATS C_p AND C_v REMAIN CONSTANT.

b) A CLOSED SYSTEM IS WHERE THE ENERGY IS CONTAINED AND THERE IS NO ENERGY LOSS SUCH AS A CYLINDER. AN OPEN SYSTEM LOOSES ENERGY WHETHER IT BE HEAT OR WORK. AN EXAMPLE OF THIS IS A TURBINE.

c) P



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

$$P_1 = 10 \times 10^5 \text{ N/m}^2$$

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

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

$$C_p = 1075 \text{ J/kgK} \quad C_v = 780 \text{ J/kgK}$$

①

$$P_1 V_1^\gamma = P_2 V_2^\gamma \quad \gamma = \frac{C_p}{C_v} = \frac{1075}{780}$$

$$\gamma = 1.38$$

$$10 \times 10^5 \times (0.25)^{1.38} = P_2 \times (0.85)^{1.38}$$

$$147624 = P_2 \times 0.8$$

$$P_2 = \frac{147624}{0.8}$$

$$P_2 = 184530 \text{ N/m}^2 \quad \text{OR } 1.8 \text{ BAR}$$

$$(ii) \frac{T_1}{T_2} = \left(\frac{V_2}{V_1} \right)^{\gamma-1} \quad \frac{423}{T_2} = \left(\frac{0.85}{0.25} \right)^{1.38-1}$$

$$\frac{423}{T_2} = 1.59 \quad T_2 = \frac{423}{1.59}$$

$$T_2 = 266^\circ\text{K}$$

(u) ~~1.1~~~~1.1~~

$$WD = \frac{P_1 V_1 - P_2 V_2}{\gamma - 1}$$

$$WD = \frac{(10 \times 10^5 \times 0.25) - (184530 \times 0.85)}{1.38 - 1}$$

$$WD = 245130 \text{ J}$$

✓

(3)

$$(v) P_1 V_1 = m R T_1 \quad m = \frac{P_1 V_1}{R T_1} \quad R = ?$$

$$R = 1075 - 780 = 295 \text{ J/kg}$$

✓

$$m = \frac{10 \times 10^5 \times 0.25}{295 \times 423}$$

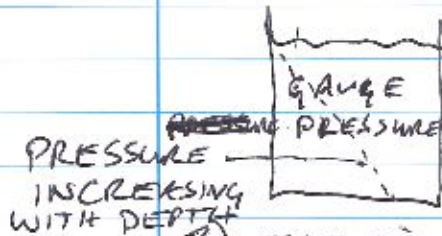
$$m = 2 \text{ Kg}$$

(4)

17

Q. a) PRESSURE HEAD - PRESSURE HEAD IS THE HEIGHT A FLUID ~~REACHES~~ ~~AND IS A MEASUREMENT~~ WHEN IT IS FLOWING THROUGH A SYSTEM ~~AND IS A MEASUREMENT OF THE PRESSURE HEIGHT.~~ (2)

b) ATMOSPHERIC GAUGE PRESSURE CONSIDERS THE DENSITY, GRAVITY AND THE DEPTH ~~HEIGHT~~ WITHIN A FLUID. (2)



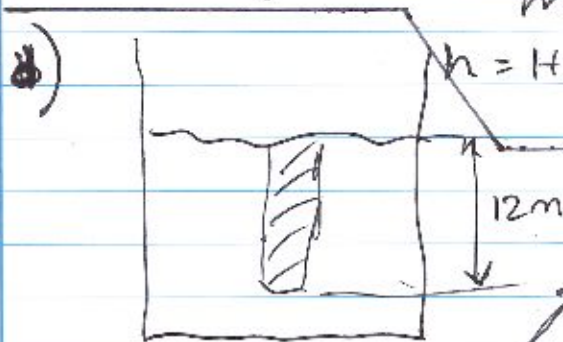
ABSOLUTE PRESSURE IS THE GAUGE PRESSURE ADDED TO THE ATMOSPHERIC PRESSURE.

THE DEEPER THE DEPTH IN A FLUID, THE HIGHER THE ~~PRESSURE IS~~ GAUGE PRESSURE IS.

c) $P_g = \rho g h$ ρ = DENSITY AND IS MEASURED IN Kg/m^3 (KILOGRAMMES PER METRE CUBED)

g = GRAVITY AND IS MEASURED IN m/s (METRES PER SECOND)

h = HEIGHT / DEPTH m (METRES)



$P_g = \rho g h$

$28 \times 10^3 = \rho \times 9.81 \times 2$

$28 \times 10^3 = \rho 19.62$

$\frac{28 \times 10^3}{19.62} = \rho$

$\rho = 1427 \text{ Kg/m}^3$

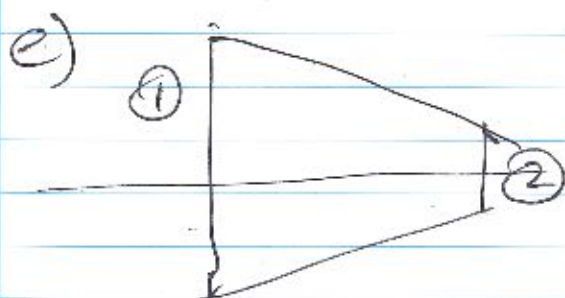
$P_g = \rho g h$

$P_g = 1427 \times 9.81 \times 12$

$P_g = 167986.44 \text{ N/m}^2 @ 12 \text{ m}$

(5)

~~Q~~ 



$$Q = 0.025 \text{ m}^3/\text{s}$$

$$P_1 = 400 \times 10^3 \text{ N/m}^2$$

$$D_1 = 0.15 \text{ m}$$

$$D_2 = 0.1 \text{ m}$$

$$\rho = 1000 \text{ kg/m}^3$$

$$P_2 =$$

$$\frac{P_1}{\rho g} + \frac{C_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{C_2^2}{2g} + Z_2$$

$$Q = C_1 A_1 \quad C_1 = \frac{Q}{A_1} \quad C_1 = \frac{0.025}{\pi \times 0.075^2} = 1.41 \text{ m/s}$$

$$Q = C_2 A_2 \quad C_2 = \frac{Q}{A_2} \quad C_2 = \frac{0.025}{\pi \times 0.05^2} = 3.18 \text{ m/s}$$

$$\frac{400 \times 10^3}{1000 \times 9.81} + \frac{1.41^2}{2 \times 9.81} = \frac{P_2}{1000 \times 9.81} + \frac{3.18^2}{2 \times 9.81}$$

$$40.77 + 0.10 = \frac{P_2}{9810} + 0.52$$

$$40.87 = \frac{P_2}{9810} + 0.52$$

$$40.87 - 0.52 = \frac{P_2}{9810}$$

$$40.35 = \frac{P_2}{9810}$$

$$P_2 = 40.35 \times 9810$$

$$P_2 = 395833.5 \text{ N/m}^2$$

$$P_2 = 395833.5 \text{ N/m}^2$$

$$\text{OR } 3.9 \text{ BAR}$$

(10)

22