



Complete, fold and seal
(see note 2 below)

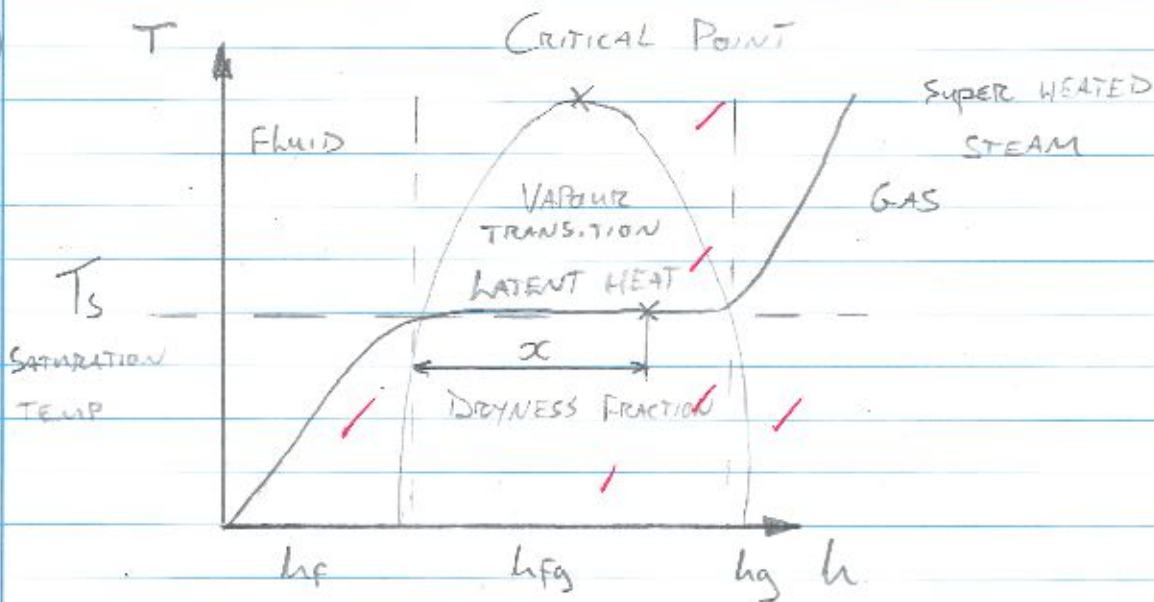
FORENAME(S): MICHAEL Ahun

12 Pages

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.

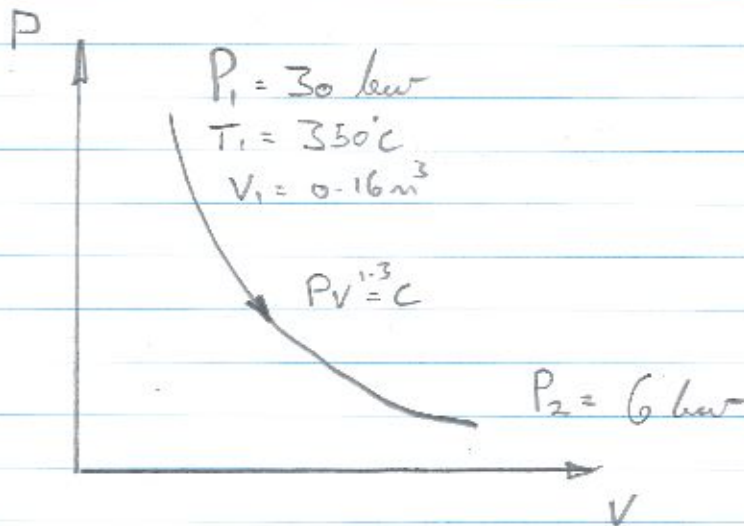
[illegible]

3a)



The diagram above shows a Temperature-Enthalpy diagram for steam. It shows that initially when heat is applied the enthalpy which is the internal energy rises in line with temperature as the water is heated until the (T_s) temperature saturation point is reached. This is where the water starts to change into a Vapour. At this stage the temp levels off and the heat energy is instead used for transitioning the state from water to steam this is known as latent heat. This transfer can be quantified by measuring the dryness fraction of the Vapour. When the dryness fraction reaches 1.0 (100%) then the temperature of the steam will again start to rise in its gaseous state known as Super heated steam.

3b)



(i) Mass of Steam = $\frac{V_1}{V_g}$

$V_g \text{ @ } 30 \text{ bar } 350^\circ = 0.0905$

Mass of Steam = $\frac{0.16}{0.0905} = \underline{\underline{1.78 \text{ kg}}}$

(ii) Final dryness fraction

from $P_1 V_1^{1.3} = P_2 V_2^{1.3}$

$30 \times 10^5 (0.16)^{1.3} = 6 \times 10^5 V_2^{1.3}$

$V_2 = \sqrt[1.3]{\frac{76800}{6 \times 10^5}}$

$V_2 = 0.206$

$V_2 = 0.206 \div 1.78 = 0.116$

$V_g \text{ @ } 6 \text{ bar } 0.3156$

dryness fraction = $\frac{0.116}{0.3156} = \underline{\underline{0.37}}$



36 (iii) The specific w.d

$$\begin{aligned} & \frac{P_1 V_1 - P_2 V_2}{n} \\ &= \frac{30 \times 10^5 \times 0.0905 - 6 \times 10^5 \times 0.116}{n} \quad \text{ECF} \\ &= 155307.7 \quad \times \\ &= 155 \text{ kw/kg} \end{aligned}$$

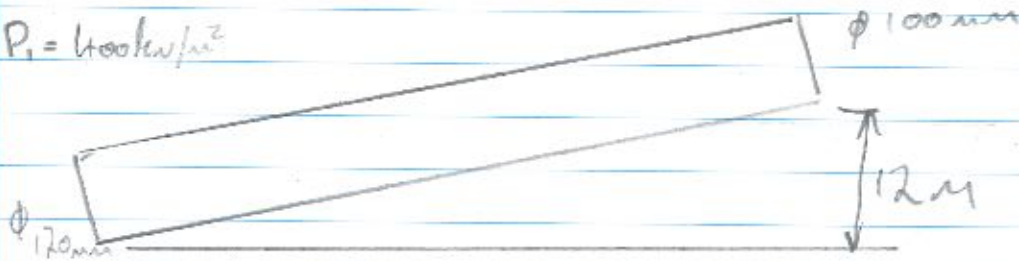
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16

2)

$$C = 100 \text{ L/s}$$

$$P_1 = 400 \text{ kN/m}^2$$



(0)

b)

upper and lower Reynolds Critical

numbers are the numbers at which flow changes from laminar to Turbulent

(4)

$$\text{Laminar} < 2000 \quad \text{Turbulent} > 4000$$

Reynolds introduced a dye into a flow of water and monitored the effect that flow had on the stream of dye. He discovered that the dye would flow in a straight line for laminar flow and would begin to be unstable as the flow increased but would again become laminar when the flow reduced.

(4)

/8/



Q4)

(1) brake thermal efficiency

$$\frac{\text{Brake power}}{\text{energy supplied}}$$

$$\begin{aligned} BP &= T \omega \\ &= 220 \times \left(2500 \times \frac{2\pi}{60} \right) \\ &= 57595.87 \text{ W} \end{aligned}$$

(5)

$$\text{Fuel energy} = M_F \times C_V \quad C_V = 44200 \text{ kJ/kg}$$

$$\text{for } M_F = \text{SFC} \times \text{Mass of fuel}$$

x (3)

$$P_V = M R T$$

Mass of air in cylinder

$$M = \frac{P_V}{RT} = \frac{1.01 \times 10^5 \times (\pi (0.055)^2 \times 0.1)}{287 \times 288}$$

(1)

$$= 1.16 \times 10^{-3} \text{ kg}$$

$$\text{Air Mass flow} = \frac{1.16 \times 10^{-3} \times 2500}{2 \times 60}$$

(6)

$$= 0.02416 \text{ kg/s}$$

$$\text{Ratio of Fuel/Air} = 1:14$$

$$= \frac{0.02416}{14}$$

(2)

$$\text{Mass flow Fuel} = 0.00173 \text{ kg/s}$$

$$\begin{aligned} \text{Fuel energy} &= 0.00173 \times 44200 \\ &= 76.47 \text{ kJ} \end{aligned}$$

/ 6 /

$$\text{Brake thermal efficiency} = \frac{57395.87}{76470} = 75.3\%$$

$$(ii) \text{ Volumetric efficiency} = \frac{\text{INDUCED VOLUME}}{\text{SWEEP VOLUME}}$$

INDUCED VOLUME =

