72991

Instructions to the candidates, if any :—

N.B. :

Solution for paper ~~E~~. (72991)

Q. No.	Marks

Q1 b) Daniel A. Crowl, III[rd] Edition Ex. 1.1.

Ans => 4.8×10^{-5}

Q2 a) Chemical process Safety by Daniel A. Crowl, III[rd] Edition, ex. 3.10.

Ans:- Q_v = 13,300 ft^3/min reqd dilution Air.

Air required = 5000 ft^3/min.

Q 3b) Chemical process safety by Daniel A. Crowl III[rd] Edition, ex. 6.2

Ans. LFL_{mix} = 2.65 by vol. total combustibles.

UFL_{mix} = 13 by vol total combustibles

Q3 c) 'chemical process safety' by Daniel Crowl, IIIrd Edition, ex 3.2.

Ans $(TLV-TWA)_{mix} = 5.5$ ppm

$\sum_{i=1}^{3} \frac{C_i}{(TLV-TWA)_i} = 6.471$ → limit exceeded.

Q5 a) At 0.5 bar, $h = 340.49$ kJ/kg

$L = 2305.4$ kg.

Enthalpy of steam as it enters the condenser

$= h + xL = 340.49 + (0.8 \times 2305.4)$

$= 2184.81$ kJ/kg.

Enthalpy of condensed water leaving the condenser.

$= 4.187(56-0) = 234.47$ kJ/kg.

∴ Heat removed / kg steam $= 2184.81 - 234.47$

$= \underline{1950.34}$ kJ/kg. – Ans

∴ $1950.34 = (m\,c_p\,\Delta T)$ cooling water.

∴ $m = \frac{1950.34}{4.187 \times 28} = \underline{16.63 \text{ kg}}$ – Ans.

Q 6 b) $I.P. = 2 P_1 V_S \frac{n}{n-1}\left[\left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} - 1\right] \times \frac{R.P.M}{60 \times 1000}$

$\therefore 62.5 = 2 \times 1 \times 10^5 (V_S \times 0.9) \times \frac{1.35}{1.35-1}\left[\left(\frac{10}{1}\right)^{\frac{0.35}{1.35}} - 1\right] \times \frac{120}{60 \times 1000}$

$\therefore V_S = 55 \times 10^3$ cu cm.

Piston speed $= 2L \times R.P.M = 200$

$\therefore L = \frac{200}{2 \times 120} = 83.4$ cm. – Ans.

$V_S = \frac{\pi}{4} D^2 L \quad \therefore D^2 = \frac{55 \times 10^3 \times 4}{\pi \times 83.4}$

$\therefore D = 20$ cm – Ans

Volumetric efficiency $\eta_v = 1 - \frac{V_c}{V_s}\left[\left(\frac{P_2}{P_1}\right)^{1/n} - 1\right]$

$\therefore 0.9 = 1 - \frac{V_c}{66 \times 10^3}\left[10^{1/1.35} - 1\right]$

$\therefore V_c = 1.47 \times 10^3$ m3.

% clearance volume $= \frac{V_c}{V_s} \times 100 = \frac{1.47 \times 10^3}{55 \times 10^3} \times 100$

$= 2.67$ % Ans.