

**Questions should be —**  
**COMPUTER LASER PRINTED OR TYPED OR WRITTEN IN LEGIBLE HANDWRITING IN BLACK INK.**  
**SIGNS, SKETCHES OR FIGURES IF ANY BE DRAWN IN NEAT BLACK INK,**  
**so as to avoid mistakes in the printed question papers.**

Questions should be written one below the other and in every front page only.

Duration ..... Hours. Total Marks assigned to the paper .....

Marks assigned to each question should be stated against each question.

**Instructions to the candidates, if any :—**

**N.B. :**

Solution for paper #. (72991)

Q. No.	Marks
Q1 b) Daniel A. Crowl, III <sup>rd</sup> Edition Ex. 1.1. Ans $\Rightarrow 4.8 \times 10^5$	
Q2 a) Chemical process Safety by Daniel A. Crowl, III <sup>rd</sup> Edition, ex. 3.10. Ans: $Q_v = 13,300 \text{ ft}^3/\text{min}$ reqd dilution Air. Air required = $5000 \text{ ft}^3/\text{min}$ .	
Q3 b) Chemical process safety by Daniel A. Crowl III <sup>rd</sup> Edition, ex. 6.2 Ans. LFL mix = 2.65 by vol. total combustibles. UFL mix = 13 by vol total combustibles	

Q3c) 'Chemical process safety' by Danvel Crowl,  
III<sup>rd</sup> Edition, Ex 3.2.

$$\text{Ans } (\text{TLV-TWA})_{\text{min}} = 5.5 \text{ ppm}$$

$$\sum_{i=1}^3 \frac{a_i}{(\text{TLV-TWA})_i} = 6.4 > 1 \rightarrow \text{limit exceeded.}$$

Q5a) At 0.5 bar,  $h = 340.49 \text{ kJ/kg}$   
 $L = 2305.4 \text{ kJ/kg}$ .

Enthalpy of steam as it enters the condenser

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

$$= 2184.81 \text{ kJ/kg.}$$

Enthalpy of condensed water leaving the condenser

$$= 4.187(56 - 0) = 234.47 \text{ kJ/kg.}$$

∴ Heat removed / kg steam =  $2184.81 - 234.47$   
 $= \underline{1950.34 \text{ kJ/kg.}} - \text{Ans}$

∴  $1950.34 = (m c_p \Delta T)_{\text{cooling water}}$

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

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

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

$$\therefore V_s = 55 \times 10^3 \text{ cu cm.}$$

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

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

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

$$\therefore D = \underline{20 \text{ cm} - \text{Ans}}$$

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

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

$$\therefore V_c = 1.47 \times 10^3 \text{ m}^3.$$

$$\% \text{ clearance volume} = \frac{V_c}{V_s} \times 100 = \frac{1.47 \times 10^3}{55 \times 10^3} \times 100 = \underline{\underline{2.67 \% - \text{Ans.}}}$$