

11/06/2016

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Plant Engineering

TE/VI/CBAS/Chem./P.E.
QP Code : 31666

(3 Hours)

[Total Marks : 80

Instruction to the candidates, if any:-

1. Q.No.1 is compulsory
2. Attempt any three from remaining five
3. Assume any suitable data if required

Q.1 Answer the following (any five)

(20)

- i. What is HAZOP? What are the steps in doing it for any flow sheet?
- ii. What is occupational hygiene?
- iii. What is the difference between a Flammable material and combustible material?
- iv. What is LOPA?
- v. Draw a P-V Diagram for two stage perfect inter cooler.
- vi. Explain why steam used for heating should be dry and saturated. Why superheated steam as well as wet steam is bad for process heating?
- vii. Explain different types of vacuum systems.

Q2. Read the following disaster carefully and answer the questions. Proper explanations for answers are essential for marks (20)

The Bombay Explosion or the Bombay Dock Explosion occurred on April 14, 1944, in Victoria Dock of Bombay, now Mumbai, when the freighter SS Fort Stikine carrying a mixed cargo of cotton bales, gold, and ammunition including around 1,400 tons of explosives, caught fire and was destroyed in two giant blasts, scattering debris, sinking surrounding ships and setting fire to the area killing around 800 people.

The SS Fort Stikine was a 7,142 gross register ton freighter built in 1942 in Prince Rupert, British Columbia. Sailing from Birkenhead on 24 February via Gibraltar, Port Said and Karachi, she arrived at Bombay on 12 April 1944. Her cargo included 1,395 tons of explosives including 238 tons of sensitive "A" explosives, torpedoes, mines, shells, munitions, Supermarine Spitfire fighter aircraft, raw cotton bales, barrels of oil, timber, scrap iron and approximately £890,000 of gold bullion in bars in 31 crates. The 87,000 bales of cotton and lubricating oil were loaded at Karachi.

The ship berthed on Bombay dock on April 14, 1944. At 14:00 hr the crew reported fire in hold No. 2 of the Ship. The crew tried to bring the fire under control by pumping water. The fire could not be brought under control, as there was dense smoke due to fire. The ship was abandoned at 15:50. Soon there was a loud explosion and the ship broke into two pieces. The ships around too, caught fire and sank. The inflammable material of the ship flew out from the ship due to explosion and set afire the nearby areas. At 16:44 another explosion rocked the ship. The intensity of the explosion hampered and decapitated the firefighting efforts. In total 800 lives were lost.

- a. What are the initiating factors of the accident?
- b. What are the causative factors for the accident?

Q.3 Obtain the theoretical COP for a CO₂ vapor refrigerator working between the temperature limits of 268 K and 298 K. The working fluid CO₂ has a dryness fraction of 0.6 at entry to the compressor. The machine is fitted with an expansion valve and there is no undercooling of liquid. The following table gives the properties of CO₂. (20)

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Sat Temp T (K)	Sat Liquid Enthalpy h (KJ/KgK)	Evaporation Enthalpy L (KJ/Kg)	Entropy of Saturated Liquid Sl (KJ/KgK)
298	81.23	121.42	0.2513
268	-7.54	245.36	-0.04187

Datum: - 0 C

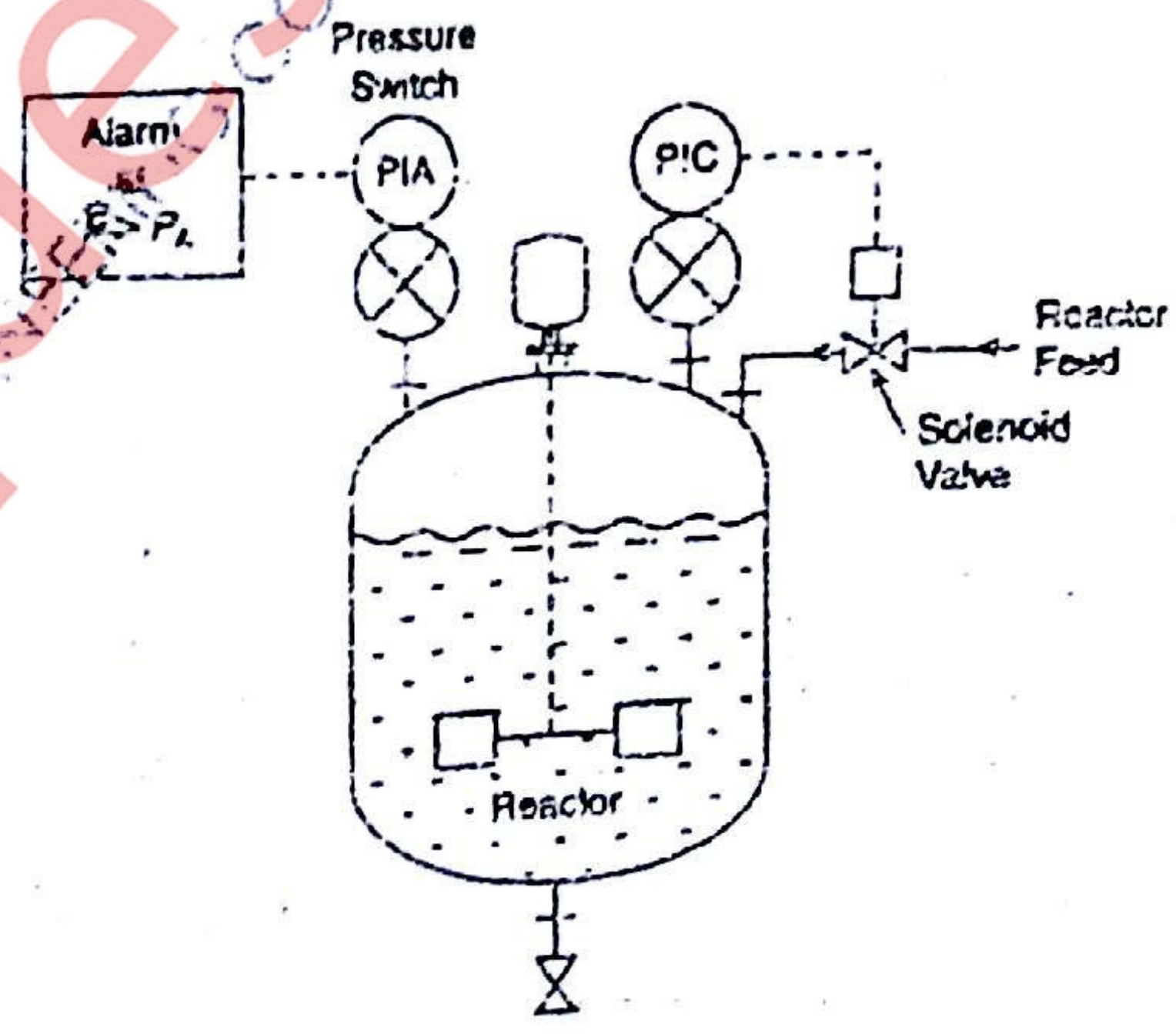
How many tonnes of ice at 0 C would a refrigerating machine, working between the same limits and having COP of 50 % make in 24 hours? The water for ice was supplied at 15 C and the compressor is driven by a 20 KW motor. The latent enthalpy of ice is 335 KJ/Kg.

Q.4 (a) What are the statistical methods available to characterize accident and loss performance? If twice as many people used motorcycles for the same average amount of time each, what will happen to (i) the OSHA incidence rate, (ii) the FAR, (iii) the fatality rate, and (iv) the total number of fatalities? If all the riders used their motorcycles twice as much, what will happen to (i) the OSHA incidence rate, (ii) the FAR, (iii) the fatality rate, and (iv) the total number of fatalities? (10)

Q.4 (b) The following data refers to a boiler plant consisting of an economizer, a boiler and a super heater. Find the boiler efficiency. (10)

- Mass of water evaporated per hour = 40000 Kg
- Mass of coal burnt per hour = 4000 Kg
- C.V. of Coal = 33400 KJ/Kg
- Pressure of steam at steam stop valve = 14 bar
- Temperature of feed water entering the economizer = 32 C
- Temperature of feed water leaving the economizer = 115 C
- Dryness fraction of steam entering the super heater = 0.96
- Temperature of steam leaving the super heater = 260 C
- Cp of superheated steam = 2.1 KJ/Kg
- At 14 bar,
- Latent heat = 1957.7 KJ/Kg, Saturation temperature = 195 C, Enthalpy of saturated water = 830.1 KJ/Kg

Q.5 (a) Consider the alarm indicator and emergency shutdown system given below. Draw a fault tree for this system. (10)



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Q.5 (b) With respect to steam distribution system in a chemical process plant answer the following questions:- (10)

- i. What is the driving force for the flow of steam in a pipe?
- ii. What is starting load & running load?
- iii. Why is steam generating and distributed at higher pressure?
- iv. Why is steam used at a lower pressure?
- v. Why is a branch line taken from the top of the header and not from side or bottom?

Q.6 Set up ANOVA table for the following information relating to three drugs testing to judge the effectiveness in reducing blood pressure for three different groups of people. (20)

Amount of Blood Pressure Reduction in Millimetres of Mercury

	Drug		
	X	Y	Z
Group of people A	14	10	11
	15	9	11
Group of people B	12	7	10
	11	8	11
Group of people C	10	11	8
	11	11	10

Do the drugs act differently?
Are the different groups of people affected differently?
Is the interaction term significant?
Answer the above questions taking a significant level of 5%.