Ref. No. : Ex/Pharm/T/215/2017 (s)

B. PHARM. 2ND YR. 1ST. SEM. SUPPLEMENTARY EXAM.-2017

Subject : INTRODUCTION TO PHARMACEUTICAL ENGINEERING

Time :3 hr **Full Marks : 100**

Answer any five questions at least two questions from each group

Group A

Q1 (a) Carry out dimensional analysis in mass transfer phenomenon and derive the dimensionally analysed correlation: in mass transfer K_c (L/θ^2), the mass transfer coefficient depends on the diffusivity, D_v (L/θ)and on other controlling variables like velocity, u; viscosity, μ; density, ρ of a fluid which is flowing through a pipe and linear dimension, D.

$K_c = f(D_v, D, u, \mu, \rho)$.What are the names of these dimensionless groups?

(b) Write short note on dimensional analysis method.

Marks 15+5

Q2(a) What is 'Graphical integration method' and what are the steps followed to carry out graphical integration?.

(b) Determine energy of activation, E (g-cal per g-mole) and frequency factor ,A (per second) by graphical plotting on semilog graph paper. The Arrhenius equation which relates specific rate of reaction (k) with temperature (absolute, T) is as follows: $k=A\ e^{-E/RT}$. Where, R is gas constant [(g-cal /(g-mole.K)].Following are the data of a chemical reaction.

Temperature,°C	110	120	130	140
k, per sec	1.07×10^{-15}	9.25×10^{-15}	6.94×10^{-14}	4.58×10^{-13}

Marks 5+15

Q.3.(a) Following are the manometer readings (R,mm) of an orifice meter with respect to average velocity (u, ft/s) of a fluid flowing through a pipe. The flow of fluid through an orifice follows an equation,

$u = kR^n$. Determine n and k by log-log graphical plotting.

u	3.42	4.25	5.25	5.88	7.02	7.30	10
R	30.3	58	75	93.5	137	148	260

(b) Write short note on ternary plotting.

Marks (15+5)

Q.4(a) Write a short note on natural draft cooling tower.

(b) It is desired to construct a drier for removing 100 pound of water per hour. Air is supplied to the d chamber at a temperature of 66°C, a pressure of 760 mm Hg, and a dew point of 4.5°C .If the air leaves the at a temperature of 35 °C, a pressure of 755 mm Hg, and a dew point of 24°C, calculate the volume of air, initial conditions, that must be supplied per hour (vapor pressure chart of water is supplied).

Marks (5+15

Q.5(a) How do you use humidity chart?

(b) Air is supplied to a living room to maintain best hygienic condition. Inlet fresh air is at a temperature °F and a relative humidity of 62% and fresh air is renewed twice each hour (twice the volume of room calculate dew point of the air in the room.(ii) If the air is taken in from the outside at a temperature of 10 °F saturated, calculate the weight of water that must be evaporated, per hour, in order to maintain the spec conditions in a room having a volume of 3000 sq.ft. (vapor pressure of water at 10°F, over ice is 1.6 mm barometric pressure is 743 mm Hg).

Marks (5+15

Water Vapor Pressure Table

Temperature (°C)	Pressure (mmHg)	Temperature (°C)	Pressure (mmHg)	Temperature (°C)	Pressure (mmHg)
0.0	4.6	19.5	17.0	27.0	26.7
5.0	6.5	20.0	17.5	28.0	28.3
10.0	9.2	20.5	18.1	29.0	30.0
12.5	10.9	21.0	18.6	30.0	31.8
15.0	12.8	21.5	19.2	35.0	42.2
15.5	13.2	22.0	19.8	40.0	55.3
16.0	13.6	22.5	20.4	50.0	92.5
16.5	14.1	23.0	21.1	60.0	149.4
17.0	14.5	23.5	21.7	70.0	233.7
17.5	15.0	24.0	22.4	80.0	355.1
18.0	15.5	24.5	23.1	90.0	525.8
18.5	16.0	25.0	23.8	95.0	633.9
19.9	16.5	26.0	25.2	100.0	760.0

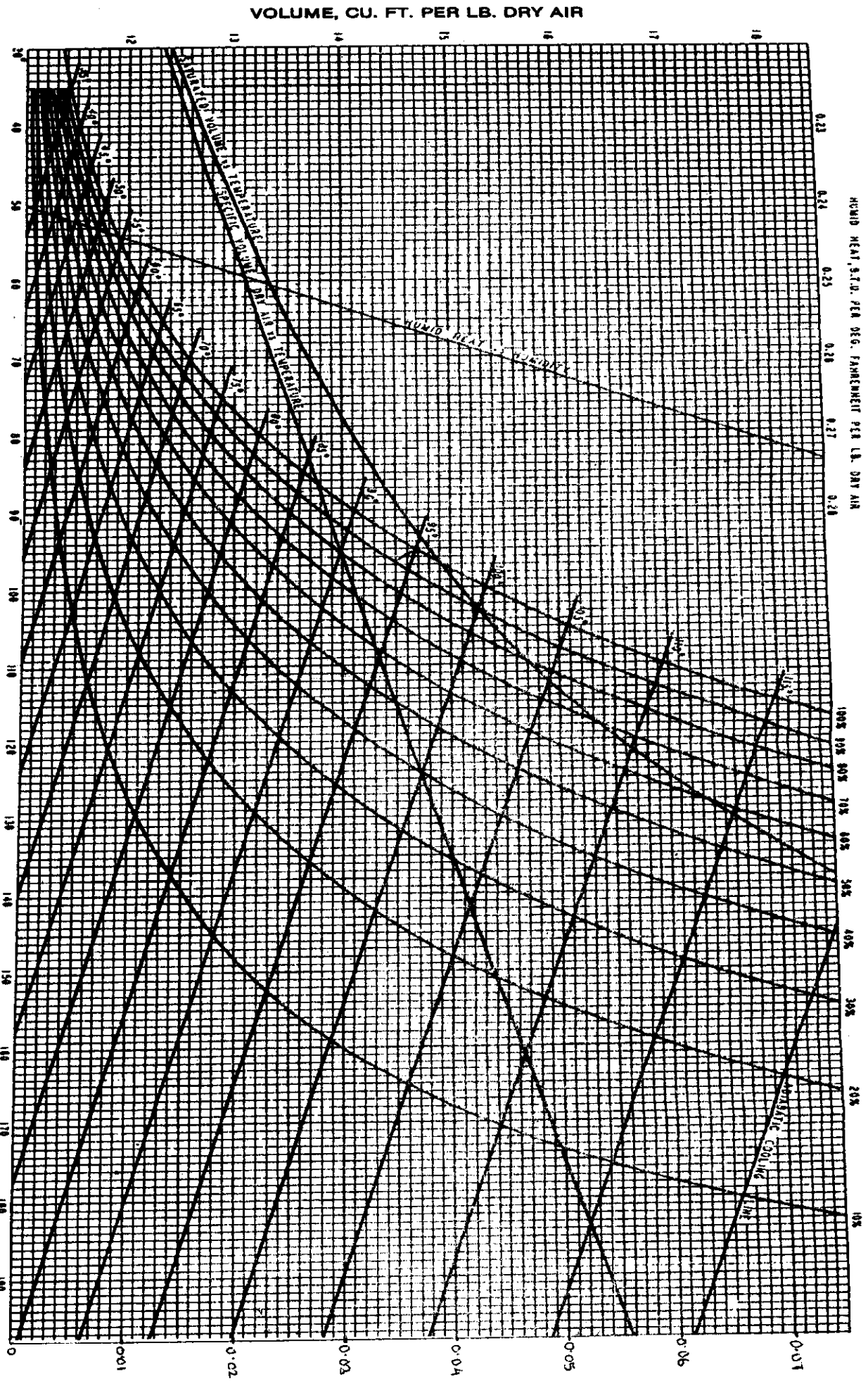

Fig. 8-8. Humidity chart for air-water vapor system at 1 atm.

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B. PHARMACY 2ND YEAR 1ST SEM SUPPLEMETARY EXAM -2017

INTRODUCTION TO PHARMACEUTICAL ENGINEERING TIME: 3 h FULL MARKS: 100

Answer any five questions, taking atleast two from each group

Group- B

1.

a. A coal slurry is to be transported by horizontal pipeline. It has been determined that the slurry may be described by the power law model with a flow index of 0.4, an apparent viscosity of 50 cP at a shear rate of 200/s, and a density of 90 lb/ft^3. What horse power would be required to pump the slurry at a rate of 1000 GPM through an 8 in. Schedule 40 pipe that is 50 miles long?

b. The velocity profile in a laminar flow is given by $\frac{v}{V_s}=\frac{3}{2}\left(\frac{y}{\partial}\right)-\frac{1}{2}\left(\frac{y}{\partial}\right)^4$. A plate 2m long and 1.4m wide is placed in flowing water whose upstream velocity is 0.2 m/sec. If viscosity $\mu = 0.02$ poise, find the boundary layer thickness at a distance of 2 m from the leading edge. Also, find λ_u and F_D on both sides of the plate.

c. The critical depth y_c in a triangular channel is a function of the discharge and acceleration g due to gravity. Show by the Rayleigh method, $y_c = \left(\frac{Q^2}{g}\right)^{1/5}$

d. For the velocity profile given below, state whether the boundary layer has separated or is on the verge of separation or will remain attached with the boundary surface.

i) $\frac{v}{V_s}=\frac{3}{2}\left(\frac{y}{\partial}\right)-\frac{1}{2}\left(\frac{y}{\partial}\right)^2$ ii) $\frac{v}{V_s}=2\left(\frac{y}{\partial}\right)^2-\left(\frac{y}{\partial}\right)^3$ iii) $\frac{v}{V_s}=-2\left(\frac{y}{\partial}\right)+\left(\frac{y}{\partial}\right)^2$

[5+5+5+5=20 marks]

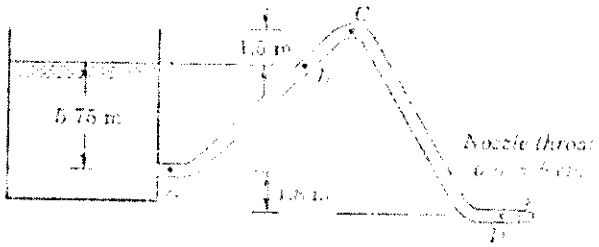
2.

a. The velocity profile within the boundary layer is given by $\frac{v}{V_s}=\frac{3}{2}\left(\frac{y}{\partial}\right)^{1/7}$. Calculate displacement and energy thickness.

b. At a point in the pipeline where the diameter is 20 cm, the velocity of water is 6 m/s and the pressure is 450 kN/m^2. At a point 20 m downstream the diameter reduces to 7m. Calculate the pressure at this point, if the pipe is a) horizontal b) vertical with flow downward c) vertical with flow upward.

c. Capillary rise h depends on density ρ, acceleration due to gravity g, surface tension σ and radius of the tube r. Show by using the Buckingham π-theorem that $\frac{h}{r}=\phi\left(\frac{\sigma}{\rho g r^2}\right)$

d. A pipe 25 cm in diameter is connected to a water tank as shown. A nozzle fitted at the end of the pipe discharges into the atmosphere. Calculate the flow rate and the pressure at A, B, C and D. Neglect losses. The diameter of the nozzle throat is 5 cm.



e. Derive the Continuity Equation in three-dimensional plane.

[4+4+4+4+4=20 marks]

3.

a. Derive Bernoulli's Equation starting from Euler's equation of motion.
b. Derive Navier-Stokes Equation starting from Reynold's Transport Theorem.
c. Derive the expression for "COUETTE FLOW".
d. Derive Hagen Poiseuille Flow. [2+6+6+6=20 marks]

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Supplementary Data