

Name Student ID

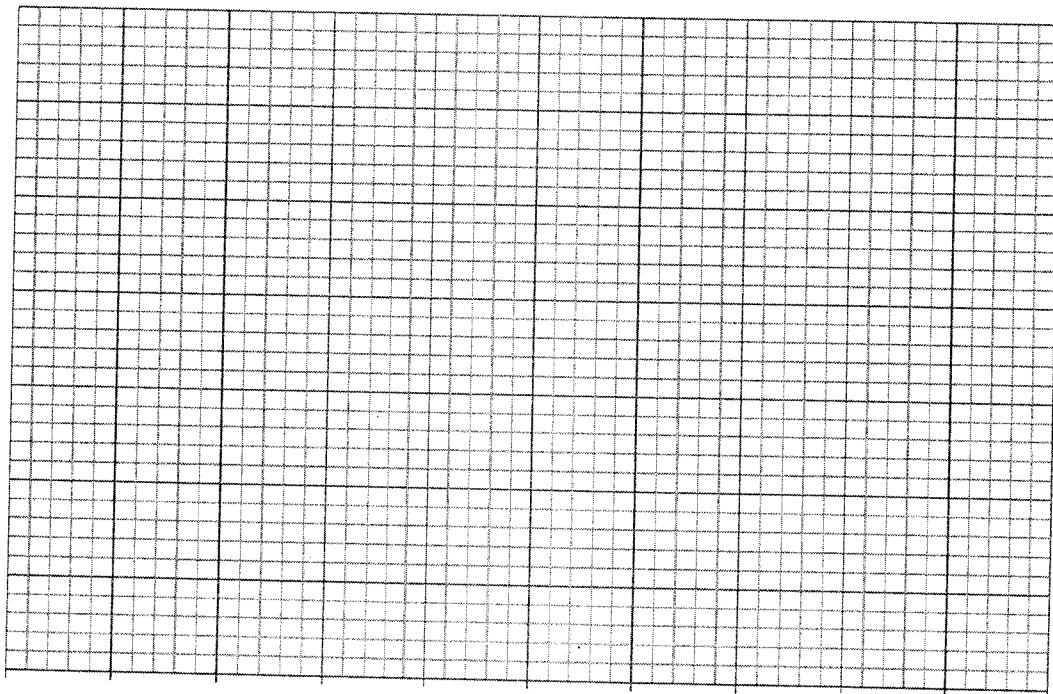
1. (30 points), Drying test of fine chemicals has been carried out in a insulated tray. The temperature of the dryer is 60°C. The dry weight of the chemicals (dry solids) is 3.765 kg and the total surface of the solids is 0.186 m². From the experimental results, the following data is obtained (as shown in the table below),

<i>Time, h</i>	0.0	0.4	0.8	1.4	2.2	3.0	4.2	5.0	7.0	9.0
<i>Solid weight, kg</i>	4.94	4.88	4.81	4.70	4.55	4.40	4.24	4.15	4.02	3.98
<i>X_T</i>										

Note that X_T is total – moisture content

1.1. (2 points), please specify that the system is cross – circulation drying or through – circulation drying?

1.2. (20 points), determine equilibrium moisture content (X^{*}), critical free moisture content (X_C), and drying rate in constant – rate period (R_C, kg/m².h) by plotting graph between X_T and time



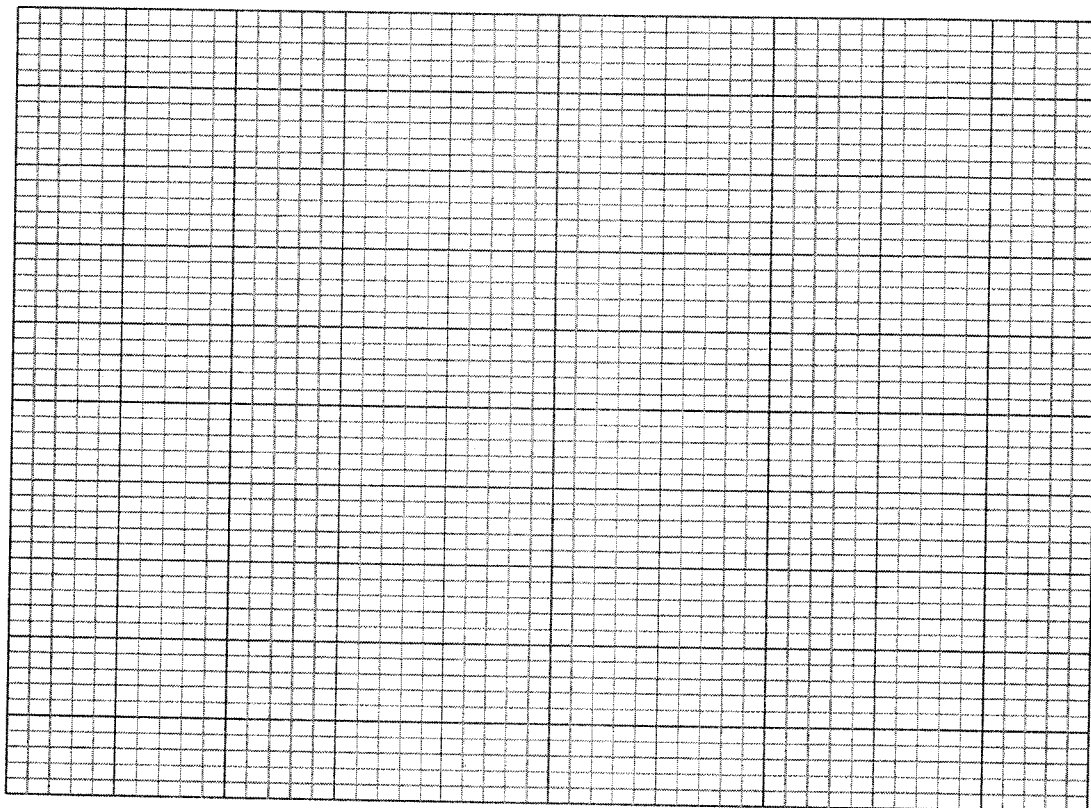
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2. (25 points), Experimental data for adsorption of water from nitrogen stream with fresh molecular sieve are given at 79°F and 86 psia as follows,

Time, h	0	10	15	15.4	15.6	15.8	16	16.2
c, ppm	<1	<1	<1	5	26	74	145	260
Time, h	16.4	16.6	16.8	17	17.2	17.6	18	18.5
c, ppm	430	610	798	978	1,125	1,355	1,465	1,490

Nitrogen feed is 29.2 mol/h.ft², and initial moisture content is 1,490 ppm. It is assumed that bulk density of bed is 44.5 lb/ft³, and the bed has a maximum capacity for H₂O of 0.32 lb/lb at that temperature.

2.1. (7 points), plot breakthrough curve, and find break – point time and ideal adsorption time



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2.2. (13 points), determine the length of unused bed (ft) and saturation capacity (lb H₂O / lb solid), if the entire bed length is 1.44 ft

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3. (20 points), A solution of MgSO_4 containing 43 g of solid per 100 g of water is cooled to 45°F in a vacuum crystallizer. During the cooling 12.53 kg of water evaporates (100 kg feed basis). The volume of liquid in the crystallizer is 7.7 m^3 and the nucleation rate is $2.7 \times 10^9 \text{ nuclei/m}^3$.

3.1. (15 points), how much solution must be fed to produce 900 kg of crystals?