淡江大學 108 學年度日間部寒假轉學生招生考試試題

系別：化學工程與材料工程學系 三年級　　科目：質能均衡　　12-1

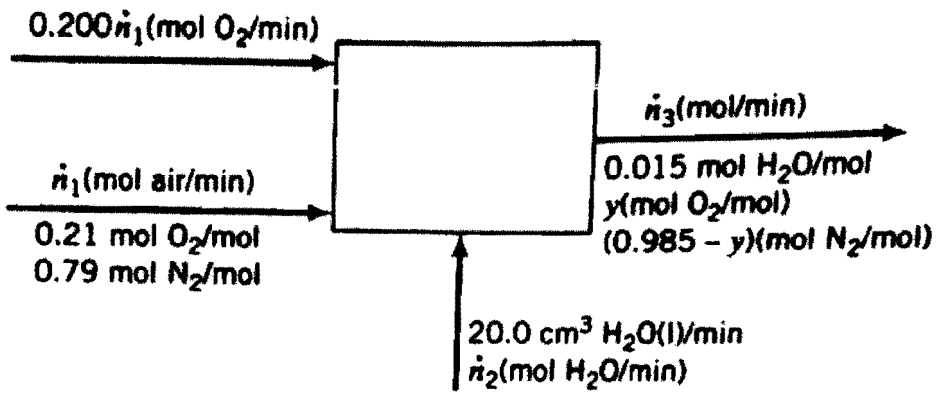
考試日期：1 月 13 日(星期一) 第 1 節　　本試題共 5 大題， 3 頁

本試題雙面印刷

注意：本科目考試可以攜帶 計算機 應試，但*不得帶手機*。

1.(25 points) An experiment on the growth rate of certain organisms requires an environment of humid air enriched in oxygen.Three input streams are fed into an evaporation chamber to produce an output stream with the desired composition.
A: Liquid water, fed at a rate of 20.0 cm^3/min
B: Air (21 mole% O_2, the balance N_2)
C: Pure oxygen, with a molar flow rate one−fifth of the molar flow rate of stream B

The output gas is analyzed and is found to contain 1.5 mole% water. A flowchart of the process is shown below. Calculate all unknown stream variables, $\dot{n}_1$, $\dot{n}_2$, $\dot{n}_3$ and y.



2.(10 points) Consider the equation

$$D(\text{ft}) = 3\ t(\text{s}) + 4$$

(a) If the equation is consistent in its units, what are the units of 3 and 4 ?
(b) Derive an equation for distance in *meters* in terms of time in *minutes*.

3.(25 points) Five hundred kilograms per hour of steam drives a turbine. The steam enters the turbine at 44 atm and 450℃ at a linear velocity of 60 m/s and leaves at a point 5 m below the turbine inlet at atmospheric pressure and a velocity of 360 m/s. The turbine delivers shaft work at a rate of 70 kW, and the heat loss from the turbine is estimated to be 10^4 kcal/h. Calculate the specific enthalpy change associated with the process.

背面尚有試題

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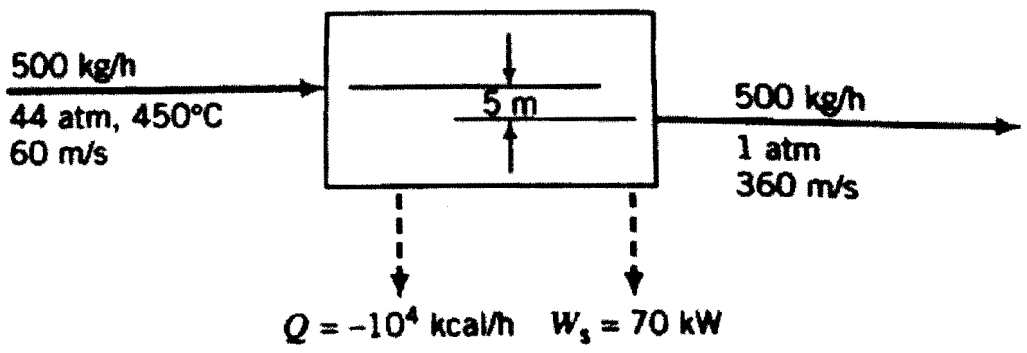
考試日期：1 月 13 日(星期一) 第 1 節　　本試題共 5 大題， 3 頁



Given the energy balance equation as the following,

$$\Delta \dot{H} = \dot{Q} - \dot{W}_s - \Delta \dot{E}_k - \Delta \dot{E}_p$$

4.(20 points) Acrylonitrile is produced in the reaction of propylene, ammonia, and oxygen:

$$C_3H_6 + NH_3 + (3/2)\,O_2 \longrightarrow C_3H_3N + 3H_2O$$

The feed contains 10.0 mole% propylene, 12.0% ammonia, and 78.0% air. A fractional conversion of 30.0% of the limiting reactant is achieved. Taking 100 mol of feed as a basis, determine which reactant is limiting, the percentage by which each of the other reactants is in excess, and the molar amounts of all product gas constituents for a 30% conversion of the limiting reactant.

5.(20 points) A ***poundal*** is the force required to accelerate a mass of 1 lb_m at a rate of 1 ft/s^2, and a ***slug*** is the mass of an object that will accelerate at a rate of 1 ft/s^2 when subjected to a force of 1 lb_f.

(a) Calculate the mass in *slugs* and the weight in *poundals* of a 175 lb_m man (i) on earth and (ii) on the moon, where the acceleration of gravity is one-sixth of its value on earth.

(b) A force of 355 *poundals* is exerted on a 25.0-*slug* object. At what rate (m/s^2) does the object accelerate?

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FACTORS FOR UNIT CONVERSIONS

Quantity	Equivalent Values
Mass	1 kg = 1000 g = 0.001 metric ton = 2.20462 lb_m = 35.27392 oz 1 lb_m = 16 oz = 5×10^{-4} ton = 453.593 g = 0.453593 kg
Length	1 m = 100 cm = 1000 mm = 10^6 microns (μm) = 10^{10} angstroms (Å) = 39.37 in. = 3.2808 ft = 1.0936 yd = 0.0006214 mile 1 ft = 12 in. = 1/3 yd = 0.3048 m = 30.48 cm
Volume	1 m^3 = 1000 L = 10^6 cm^3 = 10^6 mL = 35.3145 ft^3 = 219.97 imperial gallons = 264.17 gal = 1056.68 qt 1 ft^3 = 1728 $in.^3$ = 7.4805 gal = 0.028317 m^3 = 28.317 L = 28,317 cm^3
Force	1 N = 1 kg·m/s^2 = 10^5 dynes = 10^5 g·cm/s^2 = 0.22481 lb_f 1 lb_f = 32.174 lb_m·ft/s^2 = 4.4482 N = 4.4482×10^5 dynes
Pressure	1 atm = 1.01325×10^5 N/m^2 (Pa) = 101.325 kPa = 1.01325 bar = 1.01325×10^6 dynes/cm^2 = 760 mm Hg at 0°C (torr) = 10.333 m H_2O at 4°C = 14.696 $lb_f/in.^2$ (psi) = 33.9 ft H_2O at 4°C = 29.921 in. Hg at 0°C
Energy	1 J = 1 N·m = 10^7 ergs = 10^7 dyne·cm = 2.778×10^{-7} kW·h = 0.23901 cal = 0.7376 ft-lb_f = 9.486×10^{-4} Btu
Power	1 W = 1 J/s = 0.23901 cal/s = 0.7376 ft·lb_f/s = 9.486×10^{-4} Btu/s = 1.341×10^{-3} hp

Example: The factor to convert grams to lb_m is $\left(\frac{2.20462\ lb_m}{1000\ g}\right)$.