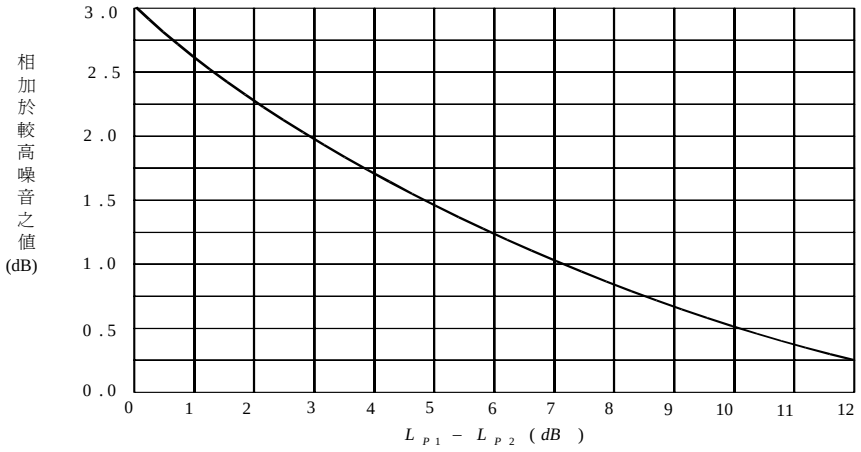
PART I 基礎題 (70%)

1. 假設汽油主要成分為異辛烷(C_8H_{18})，某都市一天約有二十萬輛車子行駛，而每輛車每天燃燒 3 加侖汽油，每加侖汽油可跑 14.4 英哩，以未控制汽車廢氣的排放因子計算(如下表)，則氮氧化物(NOx)、一氧化碳(CO)及懸浮微粒(PM)排放量各為多少? (15 分)

未控制汽車廢氣的排放因子

污染物	排放量		
	磅/英哩量/千輛汽車	磅/千加侖瓦斯	磅/汽車行駛一天
醛(HCHO)	0.3	4	0.007
一氧化碳(CO)	165.0	2,300	4.160
碳氫化合物(CH)	12.5	200	0.363
氮氧化物(NOx)	8.5	113	0.202
硫氧化物(SOx)	0.6	9	0.016
有機酸(乙酸)	0.3	4	0.007
懸浮微粒(PM)	0.8	12	0.022

2. 設計污水處理廠曝氣池之曝氣量 4000 l/sec，現有不同容量大小之曝氣機供設計時選用，甲曝氣機之曝氣量為 1000 l/sec，其噪音量為 85 dB。乙曝氣機之曝氣量為 2000 l/sec，其噪音量為 87 dB，就噪音防制之立場應如何選用曝氣機?（15 分）



音量相加計算圖

3. 某廢水處理廠 24 小時平均正常流量為 2,400 m^3/day (CMD)下，一廢水含潤滑油滴，平均粒徑d = 60 μm，密度ρ_O = 930 kg/m^3。則該粒徑 60 μm油滴在 25°C水中之上浮速度及其重力式油水分離池有效表面積需求各為何? (水密度= 997 kg/m^3; 黏滯係數=0.894×10^{-3} kg/m・s;上浮速度= $[(\rho_w - \rho_O)\, g\, d^2]/(18\mu)$) (20 分)

4. 一般習用廢棄物熱值分為高位發熱值（HHV）與低位發熱值（LHV），請分別以學理與檢測方法說明兩者之差異處？另若某廢棄物之HHV 為3,600 kcal/kg（乾基），含水量30%（重量百分比），配合計算式試估其LHV 是多少kcal/kg（濕基）？（設水之蒸發熱為600 kcal/kg，該廢棄物中氫元素含量為10%，重量百分比）（20 分）

PART II 進階題 (30%)

1. After the review of this article, please give a suitable title to cover the total paper. (10 分)
2. Please explain what are ethanol and biodiesel? From the data of this paper, which one has more benefit for environment? Why? (10 分)
3. If all U.S. corn and soybean are produced to biofuels, how much maximum the greenhouse gas emissions will be reduced? (10 分)

Negative environmental consequences of fossil fuels and concerns about petroleum supplies have spurred the search for renewable transportation biofuels. To be a viable alternative, a biofuel should provide a net energy gain, have environmental benefits, be economically competitive, and be producible in large quantities without reducing food supplies. We use these criteria to evaluate, through life-cycle accounting, ethanol from corn grain and biodiesel from soybeans. Ethanol yields 25% more energy than the energy invested in its production, whereas biodiesel yields 93% more. Compared with ethanol, biodiesel releases just 1.0%, 8.3%, and 13% of the agricultural nitrogen, phosphorus, and pesticide pollutants, respectively, per net energy gain. Relative to the fossil fuels they displace, greenhouse gas emissions are reduced 12% by the production and combustion of ethanol and 41% by biodiesel. Biodiesel also releases less air pollutants per net energy gain than ethanol. These advantages of biodiesel over ethanol come from lower agricultural inputs and more efficient conversion of feedstocks to fuel. Neither biofuel can replace much petroleum without impacting food supplies. Even dedicating all U.S. corn and soybean production to biofuels would meet only 12% of gasoline demand and 6% of diesel demand. Until recent increases in petroleum prices, high production costs made biofuels unprofitable without subsidies. Biodiesel provides sufficient environmental advantages to merit subsidy. Transportation biofuels such as synfuel hydrocarbons or cellulosic ethanol, if produced from low-input biomass grown on agriculturally marginal land or from waste biomass, could provide much greater supplies and environmental benefits than food-based biofuels. (Source: PNAS, 103(30), 11206-11230, 2006)