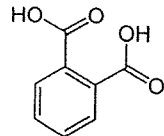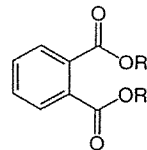1. Please tell the differences between phthalic acid (PA) and phthalate ester (e.g. di(2-ethylhexyl) phthalate (DEHP)) on their (1) molecular weight, (2) solubility, (3) boiling point, (4) octanol-water partition coefficient, K_{ow} (the hydrophobicity), (5) tendency to be adsorbed on activated carbon. (6) acidity (pKa) (7) human health hazard
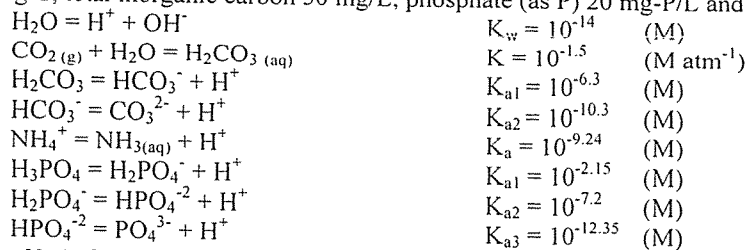
(14%)

phthalic acid

phthalate ester (R and R' are general planceholders, e.g. alkyl groups)

2. Ten kilograms of hydrogen have been leaked from a gas cylinder with inner pressure of 100 kg/cm² into an instrument room with its interior space about 100 m³. If the room temperature is 25℃ and pressure is 1 atm, will the concentration of hydrogen exceed the lower explosive limit at 4% (v/v) and create potential of explosion of the room.
(atomic weight: H=1, gas constant, R = 0.082 atmLK⁻¹mol⁻¹)

(10%)

3. How much (in unit of Kg) caustic soda alkali flake (containing 96 % sodium hydroxide, NaOH) is needed per day to raise the pH of a waste water with flow rate of 1000 cubic meter per day, total ammonia nitrogen 100 mg/L, total inorganic carbon 50 mg/L, phosphate (as P) 20 mg-P/L and pH at 6 to pH 9.5?
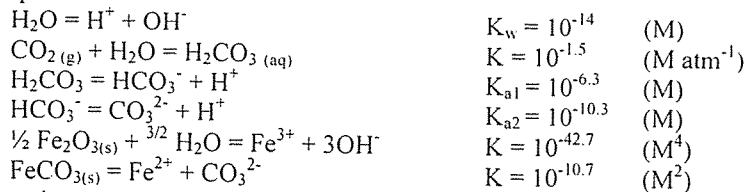
$$H_2O = H^+ + OH^-　　　　　　　　　　K_w = 10^{-14}　(M)$$
$$CO_{2\,(g)} + H_2O = H_2CO_{3\,(aq)}　　　　　K = 10^{-1.5}　(M\,atm^{-1})$$
$$H_2CO_3 = HCO_3^- + H^+　　　　　　　K_{a1} = 10^{-6.3}　(M)$$
$$HCO_3^- = CO_3^{2-} + H^+　　　　　　　K_{a2} = 10^{-10.3}　(M)$$
$$NH_4^+ = NH_{3(aq)} + H^+　　　　　　　K_a = 10^{-9.24}　(M)$$
$$H_3PO_4 = H_2PO_4^- + H^+　　　　　　K_{a1} = 10^{-2.15}　(M)$$
$$H_2PO_4^- = HPO_4^{-2} + H^+　　　　　　K_{a2} = 10^{-7.2}　(M)$$
$$HPO_4^{-2} = PO_4^{3-} + H^+　　　　　　K_{a3} = 10^{-12.35}　(M)$$

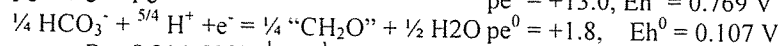(atomic weight: H=1, O=16, N=14, C=12, P=31, Na=23)

(10%)

4. There is a large amount of ferric oxide ($Fe_2O_{3(s)}$) in the soil in a rice paddy field. If the concentration of total organic carbon (with chemical formula CH_2O) is 12 mg-C/L, inorganic carbon is 12 mg-C/L, no free oxygen and pH is 7, what will be the concentration (M) of Fe^{3+} and Fe^{2+} in the soil pore water?
Reaction in the pore water:

$$H_2O = H^+ + OH^-　　　　　　　　　　K_w = 10^{-14}　(M)$$
$$CO_{2\,(g)} + H_2O = H_2CO_{3\,(aq)}　　　　　K = 10^{-1.5}　(M\,atm^{-1})$$
$$H_2CO_3 = HCO_3^- + H^+　　　　　　　K_{a1} = 10^{-6.3}　(M)$$
$$HCO_3^- = CO_3^{2-} + H^+　　　　　　　K_{a2} = 10^{-10.3}　(M)$$
$$\tfrac{1}{2}\,Fe_2O_{3(s)} + \tfrac{3}{2}\,H_2O = Fe^{3+} + 3OH^-　　K = 10^{-42.7}　(M^4)$$
$$FeCO_{3(s)} = Fe^{2+} + CO_3^{2-}　　　　　K = 10^{-10.7}　(M^2)$$

Half Redox Reactions

$$Fe^{3+} + e^- = Fe^{2+}　　　　　　　　　pe^0 = +13.0,\ Eh^0 = 0.769\ V$$
$$\tfrac{1}{4}\,HCO_3^- + \tfrac{5}{4}\,H^+ + e^- = \tfrac{1}{4}\,\text{"}CH_2O\text{"} + \tfrac{1}{2}\,H_2O \quad pe^0 = +1.8,\ Eh^0 = 0.107\ V$$

(gas constant: R = 8.314 VCK⁻¹mol⁻¹ , Faraday const. F = 96500 C mol⁻¹)

(16%)

見背面

題號： 269
國立臺灣大學 104 學年度碩士班招生考試試題
科目：環境化學及環境微生物學
節次： 7
題號： 269
共 2 頁之第 2 頁

5. What are "anaerobic", "aerobic" "hypoxic" and "anoxic" means in the field of environmental microbiology? (12%)

6. The planet earth is estimated to be 1.65×10^{22} tons. An *Escherichia coli* cell weights about 1×10^{-13} grams. Suppose one cell of E coli is inoculated into a batch (confined) culture vessel and is able to instantly undergo exponential division under optimal growth conditions with a growth rate, k (base 10) of 3 per hour: (12%)
   A. What would be the number of cells produced in the culture after 2 days of exponential growth?
   B. What would be the mass of the cells after 48 hours?
   C. Notwithstanding the limitation of nutrients and the possible toxic effect of waste products, what other limitation is there to achieving the cell number determination in question "A"? Hint: Volume of cell is about $1 um^3$.

7. Short answers: (16%)
   A. Give the typically highest oxidation state of the electron acceptor appropriate to the following types of bacteria:
      i. Denitrifying bacteria
      ii. Sulfate reducing bacteria
      iii. Manganese reducing bacteria
      iv. Iron reducing bacteria
   B. In what environment would the following physiological groups of bacteria be actively found?
      i. Denitrifying bacteria
      ii. Sulfate reducing bacteria
      iii. Manganese reducing bacteria
      iv. Iron reducing bacteria

8. What are the pros and cons of forming biofilm? (10%)

試題隨卷繳回