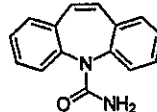
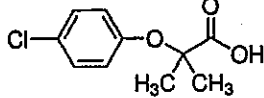


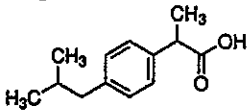
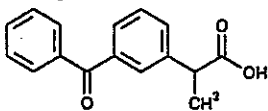
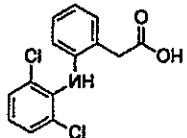
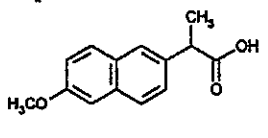
1. 為維護生物多樣性，避免物種滅絕，國際上已訂定準則去評估數以千計物種及亞種的絕種風險，請說明物種被分類成那些級別，以及依據準則(15%)
2. 人類在許多方面從生態系得著益處，綜合而言，這些益處被稱為生態系服務(ecosystem services)。請歸納說明生態系服務功能，並分類說明其定義與例證。(20%)
3. 請說明生態足跡 (Ecological Footprint)，以及如何以生態足跡 (Ecological Footprint)衡量永續性。(15%)
4. Please refer to the following abstract by Tixier et al. 2003 for question (1) - (6)

<p>Occurrence and Fate of Carbamazepine, Clofibric Acid, Diclofenac, Ibuprofen, Ketoprofen, and Naproxen in Surface Waters</p> <p>Céline Tixier, Heinz P. Singer, Sjeff Oellers, and Stephan R. Müller *</p> <p><i>Swiss Federal Institute for Environmental Science and Technology (EAWAG), Ueberlandstrasse 133, CH-8600 Dübendorf, Switzerland</i></p>	<p>ABSTRACT</p> <p>Although various single-concentration measurements of pharmaceuticals are available in the literature, detailed information on the variation over time of the concentration and the load in wastewater effluents and rivers and on the fate of these compounds in the aquatic environment are lacking. We measured the concentrations of six pharmaceuticals, carbamazepine, clofibric acid, diclofenac, ibuprofen, ketoprofen, and naproxen, in the effluents of three wastewater treatment plants (WWTPs), in two rivers and in the water column of Lake Greifensee (Switzerland) over a time period of three months. In WWTP effluents, the concentrations reached 0.95 µg/L for carbamazepine, 0.06 µg/L for clofibric acid, 0.99 µg/L for diclofenac, 1.3 µg/L for ibuprofen, 0.18 µg/L for ketoprofen, and 2.6 µg/L for naproxen. The relative importance in terms of loads was carbamazepine, followed by diclofenac, naproxen, ibuprofen, clofibric acid, and ketoprofen. An overall removal rate of all these pharmaceuticals was estimated in surface waters, under real-world conditions (in a lake), using field measurements and modeling. Carbamazepine and clofibric acid were fairly persistent. Phototransformation was identified as the main elimination process of diclofenac in the lake water during the study period. With a relatively high sorption coefficient to particles, ibuprofen might be eliminated by sedimentation. For ketoprofen and naproxen, biodegradation and phototransformation might be elimination processes. For the first time, quantitative data regarding removal rates were determined in surface waters under real-world conditions. All these findings are important data for a risk assessment of these compounds in surface waters.</p>
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Reference: Tixier C, Singer HP, Oellers S, Müller SR, "Occurrence and Fate of Carbamazepine, Clofibric Acid, Diclofenac, Ibuprofen, Ketoprofen, and Naproxen in Surface Waters." Environmental Science & Technology, 2003, VOL. 37, NO. 6, 1061 - 1068

<p>Carbamazepine</p> 	<p>MW= 236 pKa = 13.9 log Kow = 2.45 Boiling point = 411°C k^oH = 1.08×10⁻¹⁰</p>	<p>Clofibric acid</p> 	<p>MW= 215 pKa = 2.5-3.18 log Kow = 2.57 Boiling point = 324°C k^oH = 2.19×10⁻⁸</p>
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見背面

<p>Ibuprofen</p> 	<p>MW= 206 pKa = 4.91 log Kow = 4.13-4.91 Boiling point = 157°C $k^{\circ}H = 1.5 \times 10^{-7}$</p>	<p>Ketoprofen</p> 	<p>MW= 254 pKa = 4.45 log Kow = 3.12-3.16 Boiling point = 431°C $k^{\circ}H = 2.12 \times 10^{-11}$</p>
<p>Diclofenac</p> 	<p>MW= 296 pKa = 4.15 log Kow = 4.51 Boiling point = 412°C $k^{\circ}H = 4.73 \times 10^{-12}$</p>	<p>Naproxen</p> 	<p>MW= 230 pKa = 4.15 log Kow = 3.18-3.24 Boiling point = 404°C $k^{\circ}H = 3.39 \times 10^{-10}$</p>

MW: molecular weight

log Kow: octanol/water partition coefficient (log)

$k^{\circ}H$: Henry's law constant ($\text{atm m}^3 \text{ mol}^{-1}$)

(1)(10 points) Which type of water pollutant do compounds such as carbamazepine, ibuprofen and ketoprofen belong to?

- Radioactive substances
- Organic pollutants
- Trace elements
- Plant nutrients
- Pathogens

(2)(10 points) Assuming that this river in Switzerland has pH of 7.5, which compound will not exist in its protonated form?

- Carbamazepine
- Clofibrac acid
- Ibuprofen
- Ketoprofen
- Naproxen

(3)(10 points) Assuming that the biological oxygen demand (BOD) of this river in Switzerland is 5 ppm, please explain what is BOD and what can we say about this river.

(4)(10 points) Octanol/water partition coefficient (Kow) is listed in the table for each of the pharmaceuticals. Carbamazepine has log Kow = 2.45 while Diclofenac has log Kow = 4.51. Which compound is more likely to stay in the water phase based on their Kow value?

(5)(5 points) In the abstract, these 6 compounds may be removed through natural purification processes such as sorption, biodegradation and phototransformation (degradation by sunlight). If these six compounds were to contaminate our groundwater system, which process would not have an effect in the groundwater system?

(6)(5 points) In addition to these 6 pharmaceuticals, there are many antibiotics detected in our aquatic environments worldwide. What is the general concern of having various antibiotics in our river/lake systems?

試題隨卷繳回