UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2009/2010

November 2009

IEG 101 – Introduction To Environmental Science
[Pengantar Sains Persekitaran]

Duration: 3 hours
[Masa: 3 jam]

Please check that this examination paper consists of FIVE pages of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi LIMA muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

Instructions: Answer **FIVE (5)** out of six questions. You may answer the question either in Bahasa Malaysia or in English.

*[**Arahan**: Jawab **LIMA (5)** daripada enam soalan. Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai].

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1. Explain the role of any TWO of the following in water purification:

   (a) Ion Exchange.

   (b) Electrodialysis.

   (c) Reverse Osmosis.

2. (a) Briefly explain the basic characteristics of the following groups of microorganisms and name one example of a species from each of the group:

      (i) Bacteria

      (ii) Algae

      (iii) Protozoa

   (b) List the major factors influencing the rate of bacterial growth.

3. A 5.0 mL sample of wastewater is diluted to 300 mL with distilled water in standard biochemical oxygen demand (BOD) bottle. The initial dissolved oxygen (DO) in the bottle is determined to be 6.5 mg/L, and the DO after 5 days at 20°C is found to be 1.5 mg/L.

   (a) Determine the BOD_5 of the wastewater.

   (b) Calculate its ultimate BOD (BOD_L) while k= 0.5/d.

Given: (a) $BOD_5 = \dfrac{300(DO_0 - DO_5)}{V}$

(b) $BOD_t = BOD_L(1 - 10^{-kt})$

4. Calculate the total hardness, carbonate hardness, non carbonate hardness and alkalinity of a sample of water having the following concentrations of ions.

Ion	Concentration (mg/L)	Molecular Weight (mg/mmol)
Ca^{2+}	40	40.1
Mg^{2+}	10	24.3
Na^{+}	11.8	23.0
K^{+}	7.0	39.1
HCO^{3-}	110	61.0
SO_4^{2-}	67.2	96.1
Cl^{-}	11	35.5
$pH_{water} = 7.2$		
$k = [CO_3^{2-}][H^{+}]/[HCO_3^{-}] = 10^{-10.33}$		

5. (a) Write short notes on the following:

   (i) Coagulation and Flocculation

   (ii) Accuracy and Precision

   (b) Explain the nitrogen cycle and its role in the environment.

6. (a) How will you prepare 250 mL of each of the following solutions?

Solutions	Molecular Weight (g/mol)
0.1 N NaOH	40
0.01 N HCl	36.5
0.005 M H_2SO_4	98
0.01 N NaCl	58.5

   (b) Calculate pH as well as pOH of these solutions.

   (c) What will be the concentrations of these solutions in ppm?

1. *Jelaskan peranan mana-mana DUA yang berikut dalam pembersihan air:*

   (a) Penukaran Ion.

   (b) Elektrodialisis.

   (c) Osmosis Berbalik.

2. *(a) Secara ringkas terangkan ciri-ciri asas bagi kumpulan mikroorganisma berikut dan namakan satu contoh spesis daripada setiap kumpulan:*

   (i) Bakteria

   (ii) Alga

   (iii) Protozoa

   (b) Senaraikan faktor-faktor utama yang mempengaruhi kadar pertumbuhan bakteria.

3. *Sebanyak 5.0 mL sampel air sisa dicairkan sehingga 300 mL dengan menggunakan botol keperluan oksigen biokimia (BOD). Oksigen terlarut (DO) di dalam botol didapati bernilai 6.5 mg/L, dan oksigen terlarut (DO) selepas 5 hari pada 20°C didapati bernilai 1.5 mg/L.*

   (a) Tentukan BOD_5 bagi air sisa tersebut.

   (b) Kirakan BOD muktamad (BOD_L) air sisa tersebut sekiranya k= 0.5/d.

   Diberi: (a) $BOD_5 = \dfrac{300(DO_0 - DO_5)}{V}$

   (c) $BOD_t = BOD_L(1 - 10^{-kt})$

4. *Hitungkan keliatan keseluruhan, keliatan karbonat, keliatan bukan karbonat dan kealkalian satu sampel air yang mempunyai kepekatan ion berikut:*

Ion	*Kepekatan (mg/L)*	*Berat Molekul (mg/mmol)*
Ca^{2+}	*40*	*40.1*
Mg^{2+}	*10*	*24.3*
Na^{+}	*11.8*	*23.0*
K^{+}	*7.0*	*39.1*
HCO^{3-}	*110*	*61.0*
SO_4^{2-}	*67.2*	*96.1*
Cl^{-}	*11*	*35.5*
$pH_{water} = 7.2$		
$k = [CO_3^{2-}][H^{+}]/[HCO_3^{-}] = 10^{-10.33}$		

5. *(a) Tulis nota ringkas mengenai perkara berikut:*

   (i) Pengentalan dan Penggumpalan.

   (ii) Kejituan dan Kepersisan.

   (b) Jelaskan tentang kitar nitrogen dan peranannya dalam sekitaran.

6. *(a) Bagaimanakah 250 mL setiap larutan yang berikut dapat disediakan?*

Larutan	*Berat Molekul (g/mol)*
0.1 N NaOH	*40*
0.01 N HCl	*36.5*
0.005 M H_2SO_4	*98*
0.01 N NaCl	*58.5*

   (b) Hitungkan pH serta pOH larutan-larutan tersebut.

   (c) Apakah kepekatan larutan-larutan tersebut dalam ppm?

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