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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014**

COURSE NAME : CHEMISTRY FOR ENGINEERING
TECHNOLOGY
COURSE CODE : BWM 12703
PROGRAMME : 1 BNA / BNB / BNC / BNN
EXAMINATION DATE : DECEMBER 2013/JANUARY 2014
DURATION : 3 HOURS
INSTRUCTION : A) ANSWER ALL QUESTIONS
B) ANSWER ONE (1)
QUESTION ONLY

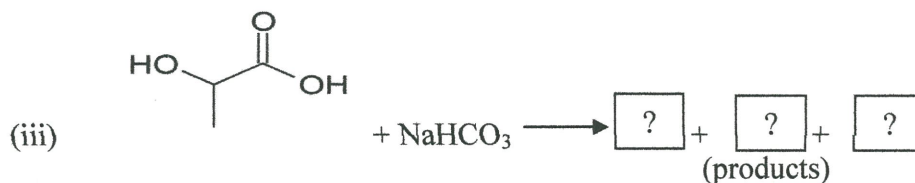
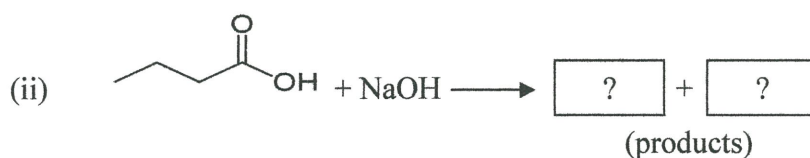
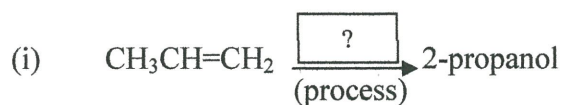
THIS QUESTION PAPER CONSISTS OF EIGHT (8) PAGES

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SECTION A

- Q1** (a) Describe the **TWO (2)** environmental factors affecting corrosion design. (4 marks)
- (b) By retarding either the anodic or cathodic reactions, the rate of corrosion can be reduced. Suggest **FOUR (4)** other solutions that would reduce the corrosion rate. (8 marks)
- (c) Discuss the mechanism of differential aeration corrosion in detail with the aid of diagram and an example. (8 marks)

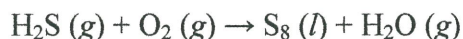
- Q2** (a) By referring to **FIGURE 1**, name this hydrocarbon in accordance to IUPAC rules. Identify the functional groups that present in the chemical structure. (4 marks)
- (b) Complete the chemical reaction below by providing the correct process or the structural formula of the product.



(6 marks)

- (c) Draw the products of the treatment of each of the following alcohols with pyridinium chlorochromate (PCC):
- (i) 1-Hexanol
 - (ii) 2-Hexanol
 - (iii) Cyclohexanol
- (6 marks)
- (d) State the function of Grignard reagent. Predict the type of alcohol produced by the addition of Grignard reaction to these hydrocarbon:
- (i) Formaldehyde
 - (ii) Acetaldehyde
 - (iii) Ketone
- (4 marks)
- Q3**
- (a) Discuss **THREE (3)** primary uses of Ultraviolet-visible spectroscopy (UV-VIS).
- (6 marks)
- (b) Can Atomic absorption spectroscopy (AAS) be used to study qualitative and quantitative elemental analyses of samples? Explain your answer.
- (6 marks)
- (c) Morphological study of filler dispersion in ceramic composites can be examined via Instrument Z. Suggest the name of instrument Z and briefly describe its principle and applications.
- (8 marks)
- Q4**
- (a) The oxygen element has three naturally occurring isotopes, with 8, 9, and 10 neutrons in the nucleus, respectively.
- (i) Write the full chemical symbols for these three isotopes.
 - (ii) Describe the similarities and differences between the three kinds of oxygen isotopes.
- (5 marks)

- (b) Hydrogen sulfide is an impurity in natural gas that must be removed. One common removal method is called the Claus process, which relies on the reaction:



- (i) Balance this chemical equation.
(ii) Under optimal conditions, the Claus process gives 98% yield of S_8 from H_2S . By assuming 98% yield, if the reaction started with 30.0 grams of H_2S and 50.0 grams of O_2 , calculate the amount of S_8 (grams) that would be produced.

(10 marks)

- (c) With the aid of diagrams, discuss the differences between Ion-Dipole, Dipole-Dipole and London Dispersion Forces.

(5 marks)

SECTION B

- Q5** (a) A scuba diver's tank contains 0.29 kg of O_2 compressed into a volume of 2.3 L.

- (i) Calculate the gas pressure inside the tank at 9 °C.
(ii) What volume would this oxygen occupy at 26 °C and 0.95 atm.

(6 marks)

- (b) An unknown gas composed of homonuclear diatomic molecules effuses at a rate that is 0.355 times the rate at which O_2 gas effuses at the same temperature. Calculate the molar mass of the unknown gas.

(4 marks)

- (c) Carbonic acid plays an important role in keeping the body's pH stable. It is a chemical compound with the formula H_2CO_3 .
- Calculate the pH and the concentrations of all species present (H_2CO_3 , HCO_3^- , CO_3^{2-} , H_3O^+ and OH^-) in a 0.020 M H_2CO_3 solution.
 - What percentage of the acid is ionized in this 0.020 M H_2CO_3 solution.

$$(K_w = 1.0 \times 10^{-14}; K_{a1} = 4.3 \times 10^{-7}; K_{a2} = 5.6 \times 10^{-11})$$

(10 marks)

- Q6** (a) Two solutions, initially at 24.60 °C, are mixed in a coffee cup calorimeter ($C_{\text{cal}} = 15.5 \text{ J } ^\circ\text{C}^{-1}$). When a 100.0 mL volume of 0.100 M AgNO_3 solution is mixed with a 100.0 mL sample of 0.200 M NaCl solution, the temperature in the calorimeter rises to 25.30 °C. Evaluate the ΔH_{rxn} (in units of kJ mol^{-1}) for the reaction as written below (reaction occurs at constant pressure).



(Assume that the specific heat of the aqueous mixture is $4.18 \text{ J g}^{-1} \text{ } ^\circ\text{C}^{-1}$)

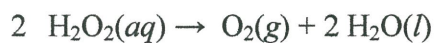
(6 marks)

- (b) Consider that the following enthalpy changes are known for the stated reactions (1)-(3) below. Determine the enthalpy change for reaction (4).



(6 marks)

- (c) The decomposition of hydrogen peroxide in diluted sodium hydroxide solution is described by the equation



The reaction is first order in H_2O_2 , the rate constant for the consumption of H_2O_2 at 20 °C is $1.8 \times 10^{-5} \text{ s}^{-1}$ and the initial concentration of H_2O_2 is 0.30M.

- (i) What is the concentration of H_2O_2 after 4.00 h?
- (ii) How long will it take for the H_2O_2 concentration to drop to 0.12M?
- (iii) How long will it take for 90% of the H_2O_2 to decompose?

(8 marks)

- END OF QUESTION -

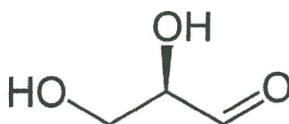
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**FIGURE 1:** The chemical structure of hydrocarbon.**TABLE 1:** Gas constant values with different units

<i>R</i>	Unit
0.0821	L.atm/mol.K
8.3145×10^3	L.Pa/mol.K
8.3145	J/K.mol
8.3145	m ³ .Pa/K.mol

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TABLE 2: Mass of Atoms

Element	Symbol	Atomic number (Z)	Atomic mass (A)	Element	Symbol	Atomic number (Z)	Atomic mass (A)
Actinium	Ac	89	227.0278	Mercury	Hg	80	200.59
Aluminum	Al	13	26.98154	Molybdenum	Mo	42	95.94
Americium	Am	95	(243)	Neodymium	Nd	60	144.24
Antimony	Sb	51	121.75	Neon	Ne	10	20.179
Argon	Ar	18	39.948	Neptunium	Np	93	237.0482
Arsenic	As	33	74.9216	Nickel	Ni	28	58.70
Astatine	At	85	(210)	Niobium	Nb	41	92.9064
Barium	Ba	56	137.33	Nitrogen	N	7	14.0067
Berkelium	Bk	97	(247)	Nobelium	No	102	(259)
Beryllium	Be	4	9.01218	Osmium	Os	76	190.2
Bismuth	Bi	83	208.9804	Oxygen	O	8	15.9994
Boron	B	5	10.81	Palladium	Pd	46	106.4
Bromine	Br	35	79.904	Phosphorus	P	15	30.97376
Cadmium	Cd	48	112.41	Platinum	Pt	78	195.09
Calcium	Ca	20	40.08	Plutonium	Pu	94	(244)
Californium	Cf	98	(251)	Polonium	Po	84	(209)
Carbon	C	6	12.011	Potassium	K	19	39.0983
Cerium	Ce	58	140.12	Praseodymium	Pr	59	140.9077
Cesium	Cs	55	132.9054	Promethium	Pm	61	(145)
Chlorine	Cl	17	35.453	Protactinium	Pa	91	231.0359
Chromium	Cr	24	51.996	Radium	Ra	88	226.0254
Cobalt	Co	27	58.9332	Radon	Rn	86	(222)
Copper	Cu	29	63.546	Rhenium	Re	75	186.207
Curium	Cm	96	(247)	Rhodium	Rh	45	102.9055
Dysprosium	Dy	66	162.50	Rubidium	Rb	37	85.4678
Einsteinium	Es	99	(254)	Ruthenium	Ru	44	101.07
Erbium	Er	68	167.26	Samarium	Sm	62	150.4
Europium	Eu	63	151.96	Scandium	Sc	21	44.9559
Fermium	Fm	100	(257)	Selenium	Se	34	78.96
Fluorine	F	9	18.998403	Silicon	Si	14	28.0855
Francium	Fr	87	(223)	Silver	Ag	47	107.868
Gadolinium	Gd	64	157.25	Sodium	Na	11	22.98977
Gallium	Ga	31	69.72	Strontium	Sr	38	87.62
Germanium	Ge	32	72.59	Sulfur	S	16	32.06
Gold	Au	79	196.9665	Tantalum	Ta	73	180.9479
Hafnium	Hf	72	178.49	Technetium	Tc	43	(97)
Helium	He	2	4.00260	Tellurium	Te	52	127.60
Holmium	Ho	67	164.9304	Terbium	Tb	65	158.9254
Hydrogen	H	1	1.0079	Thallium	Tl	81	204.37
Indium	In	49	114.82	Thorium	Th	90	232.0381
Iodine	I	53	126.9045	Thulium	Tm	69	168.9342
Iridium	Ir	77	192.22	Tin	Sn	50	118.69
Iron	Fe	26	55.847	Titanium	Ti	22	47.90
Krypton	Kr	36	83.80	Tungsten	W	74	183.85
Lanthanum	La	57	138.9055	Uranium	U	92	238.029
Lawrencium	Lr	103	(260)	Vanadium	V	23	50.9414
Lead	Pb	82	207.2	Xenon	Xe	54	131.30
Lithium	Li	3	6.941	Ytterbium	Yb	70	173.04
Lutetium	Lu	71	174.97	Yttrium	Y	39	88.9059
Magnesium	Mg	12	24.305	Zinc	Zn	30	65.38
Manganese	Mn	25	54.9380	Zirconium	Zr	40	91.22
Mendelevium	Md	101	(258)				