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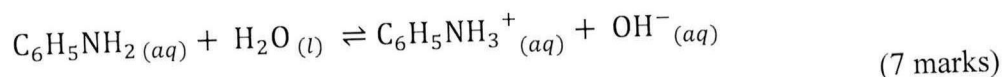
**FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020**

COURSE NAME : CHEMISTRY FOR ENGINEERING TECHNOLOGY
COURSE CODE : BWM 12703
PROGRAMME CODE : BNA
EXAMINATION DATE : DECEMBER 2019/ JANUARY 2020
DURATION : 3 HOURS
INSTRUCTION : ANSWER ALL QUESTIONS

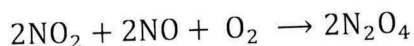
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THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

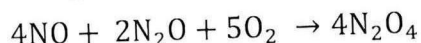
- Q1** (a) Solutions are homogeneous mixtures containing one or more solutes in a solvent. The solvent that makes up most of the solution, whereas a solute is a substance that is dissolved inside the solvent.
- (i) Classify briefly **TWO (2)** common units of solution concentration based on moles. (2 marks)
- (ii) Molarity is used to express the concentration of a solution. Calculate the molarity of a solution that contains 85 g iodine (I₂) dissolved in 250 mL of ethanol (C₂H₅OH). (4 marks)
- (b) Determine the mass of argon (Ar) contained in an 18.6 L container at 20°C with a pressure of 2.35 atm. (4 marks)
- (c) A mixture of 2 mol of hydrogen (H₂) and 3 mol of helium (He) exerts a total pressure of 3 atm. Determine the partial pressure of He. (3 marks)
- (d) The pH of a 0.1 M solution of aniline (C₆H₅NH₂) solution was found to be 8.79. Determine the value of K_b for aniline if the dissociation occurs as below:



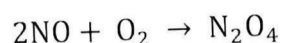
- Q2** (a) Based on the reactions below:



$$\Delta H = -228.54 \text{ kJ}$$



$$\Delta H = -488.46 \text{ kJ}$$



$$\Delta H = -171.34 \text{ kJ}$$

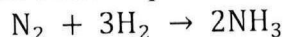
By applying the Hess Law, determine the enthalpy (ΔH) for



- (b) 14 grams of metal were heated from 297 K until the heat absorbed by the metal is equal to 250 joules. The metal's specific heat is 0.105 J/g°C. Determine its final temperature in Kelvin. (3 marks)
- (c) The decomposition of aqueous hydrogen peroxide to gaseous oxygen and water is a first-order reaction. If it takes 6.5 hours for the concentration of hydrogen peroxide (H₂O₂) to decrease from 0.70 to 0.35, how long does it take for the concentration to decrease from 0.40 to 0.10? (7 marks)

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- (d) The rate of formation of ammonia (NH_3) is 0.345 M/s. Determine the rate of disappearance of H_2 if the reaction proceeds as follows:



(3 marks)

- Q3** (a) Corrosion is a reduction-oxidation reaction in which metal is being oxidized by its surroundings. This reaction is both spontaneous and electrochemically favored. Illustrate with diagram the corrosion of steel in the presence of water. (4 marks)
- (b) According to "X" theory, iron is corroded by atmospheric carbon dioxide, moisture and oxygen. The corrosion products are the mixture of ferrous bicarbonate ($\text{Fe}(\text{HCO}_3)_2$), iron carbonate hydroxide ($\text{Fe}(\text{OH})\text{CO}_3$) and ferric hydroxide ($\text{Fe}(\text{OH})_3$). Categorize "X" based on the explanation above. (2 marks)
- (c) The corrosion that caused by localized breakdown of metal manifesting in small cavities or pits can cause the deadly damage to infrastructure and industrial assets. As an example, the U.S. Highway 35 bridge collapse in 1967 where the investigators determined a small crack formed when one of the bridge's eyebeam was cast decades before the collapse.
- (i) Identify the type of corrosion occurred to the bridge. (2 marks)
- (ii) By understanding the type of corrosion answered in **Q3 (c)(i)**, suggest in detail the prevention method that might be useful to control the corrosion. (8 marks)
- (d) The two factors that govern the corrosion process are metallic and environmental factors. Explain in detail **FOUR (4)** environmental factors that contribute to the corrosion. (4 marks)
- Q4** (a) Identify and determine the IUPAC name and their functional groups of both hydrocarbon shown in **Figure Q4 (a)**. (4 marks)
- (b) A functional group is a specific group of atoms or bonds within a compound that is responsible for the characteristic chemical reactions of that compound. The same functional group will have similar properties by undergoing similar reactions, regardless of the compound of which it is a part. Categorize common different functional groups in terms of its chemical classes, group, and example of the structural formula. (4 marks)
- (c) Alcohol can be classified based on which carbon atom is bonded to the hydroxyl group. By using 4 carbon chain of alcohol as an example, explain with the aid of structural formula the classification of alcohols.

(6 marks)

(d) Carboxylic acid is a homologous series in which the compounds contain a functional group called the carboxyl group (-COOH).

(i) Describe with examples, the types of carboxylic acid. (3 marks)

(ii) Carboxylic acids are easily reduced by strong reducing agent such as lithium aluminium hydride (LiAlH₄). Illustrate with the aid of structural formula, the reduction reaction of 2-methylheptanoic acid. (3 marks)

Q5 (a) The atomization process is the main step in measuring the concentration of element using Atomic Absorption Spectroscopy (AAS).

(i) Name the component in AAS that act as atomizer where the ions are reduced to gaseous metal atoms. (1 mark)

(ii) Describe in detail the atomization process occurs at component answered in **Q5 (a)(i)**. (6 marks)

(b) The determination of an analyte's concentration based on its absorption of ultraviolet or visible radiation is one of the most frequently encountered quantitative analytical methods. Explain the method to measure the concentration of substance in an unknown sample. (5 marks)

(c) Interferogram is a signal produced by an optical device called "Y" which has the unique property that every data from the signal has information about every frequency which comes from the source.

(i) Identify the analytical instruments that having the optical device called "Y". (2 marks)

(ii) Describe in detail the criteria for a compound to be analyzed by analytical instruments answered in **Q5 (c)(i)**. (6 marks)

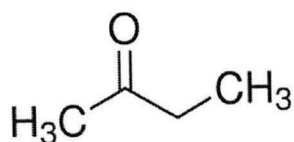
-END OF QUESTIONS -

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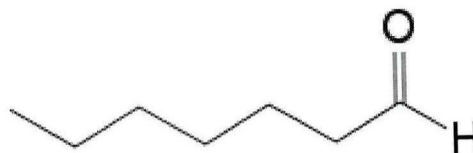
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(A)



(B)

Figure Q4(a)

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: Atomic number and mass

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)				