FACULTY OF SCIENCE

DEPARTMENT OF CHEMICAL SCIENCES
NATIONAL DIPLOMA: ANALYTICAL CHEMISTRY

MODULE: CETXTB1
CHEMISTRY 1

CAMPUS: DFC

SUPPLEMANTARY EXAMINATION 2019

NUMBER OF PAGES: **5**

INSTRUCTIONS: ANSWER ALL QUESTIONS IN PEN. GIVE ALL NUMERICAL ANSWERS TO THE CORRECT NUMBER OF SIGNIFICANT FIGURES AND WITH APPROPRIATE UNITS.

REQUIREMENTS: ANSWER SCRIPT

QUESTION 1

1.1   In a reaction, O_2 is produced at STP, and it occupied a container that has length, width and height of 0.400 m, 0.400 m and 0.500 m respectively. How many molecules of O_2 were produced in the reaction?
[1 m = 10 dm; 1 dm^3 = 1 L]   (6)

1.2   A 0.2417 g sample of a compound composed of C,H,O,Cl only, is burned in oxygen yielding 0.4964 g of CO_2 and 0.0846 g of H_2O. A separate 0.1696 g sample of the compound is fused with sodium metal, the products dissolved in water and the chloride quantitatively precipitated with $AgNO_3$ to yield 0.1891 g of AgCl. What is the empirical formula for the compound?   (11)

1.3   A mass of 34.0 g of aluminium reacts with 39.0 g of chlorine gas to form aluminium chloride.

1.3.1   What is the mass of aluminium chloride produced in this reaction?   (5)
1.3.2   What mass of the reactant is left after the completion of this reaction   (2)

1.4   Give four reasons why actual yield is usually less than theoretical yield.   (4)

1.5   A mass of 950.0 g of copper(II) sulfate was reacted with 460.0 g of zinc metal. If 295.8 g of copper are actually obtained from this reaction, what is the percent yield?   (5)

1.6   Chalk is an almost pure form of calcium carbonate. A 20.0 g mass of chalk was reacted with an excess of dilute hydrochloric acid to produce calcium chloride, water and 4.256 L of carbon dioxide gas which was collected at standard temperature and pressure (STP).

1.6.1   Write a balanced equation for this reaction.   (2)
1.6.2   What mass in grammes of carbon dioxide is produced?   (2)
1.6.3   Calculate the percentage purity of the chalk.   (4)

[41]

QUESTION 2

2.1   Phenylacetic acid ($C_6H_5CH_2COOH$, denoted as HPAc) builds up in the blood of people afflicted with phenylketonuria, an inherited genetic disorder that, if left untreated, causes mental retardation and death. A study of the acid shows that the pH of a 0.12 M solution of HPAc is 2.60. This dissociation equation is given as:

$$HPAc(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + PAc^-(aq)$$
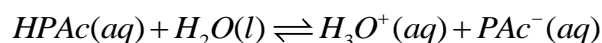
2.1.1   Calculate the percentage ionisation of this weak acid.   (3)
2.1.2   What is the K_a of phenylacetic acid?   (3)

2.2   Calculate the molarity of a household ammonia whose pH is 11.5. The dissociation constant (K_b) for ammonia at room temperature is 1.8 x 10^{-5}.   (6)

2.3   Calculate the pH of a sodium hydroxide solution which was prepared by dissolving 2.50 g of sodium hydroxide pellet in 250 mL of water   (5)

[17]

QUESTION 3

3.1   Draw a suitable Lewis structure for CH_3NO_2. All hydrogens are bonded to carbon, and the order of atomic connections is CONO.   (3)

3.2   Based on the Valence Shell Electron Pair Repulsion (VSEPR) Theory? What is the shape of the following molecules?

3.2.1 BF_3 (2)
3.2.2 CCl_4 (2)
3.2.3 NH_3 (2)

3.3   Based on the VSEPR model, water is a linear molecule. True or False? Defend your choice with suitable explanation(s).   (3)

[12]

QUESTION 4

4.1   Predict the product of the following displacement reaction (if any) by writing a balanced chemical equation.

4.1.1 $Zn(s) + Al_2(NO_3)_3(aq) \rightarrow$ (3)
4.1.2 $Sn(s) + HCl(aq) \rightarrow$ (3)

4.2   What is effective nuclear charge?   (2)

4.3   Rank the following elements in order of increasing (smallest to largest) atomic radii

4.3.1   C, N, Mg, Al, and Si   (2)
4.3.2   Li, Na, K, Rb, and Cs   (2)
4.3.3   Si, P, S, Cl, and Ar   (2)

4.4   Which of the following processes requires the most ionisation energy? Explain your choice.   (5)
        a. $Na(g) \rightarrow Na^+(g) + e^-$
        b. $Na^+(g) \rightarrow Na^{2+}(g) + e^-$
        c. $Mg(g) \rightarrow Mg^+(g) + e^-$
        d. $Mg^+(g) \rightarrow Mg^{2+}(g) + e^-$

[19]

QUESTION 5

Name the following organic compounds:

$$CH_3-CH_2-\overset{\overset{\displaystyle CH_2}{\|}}{C}-CH_2-\overset{\overset{\displaystyle CH_2-CH_3}{|}}{\underset{\underset{\displaystyle CH_3}{|}}{C}}-CH_3$$

5.1   (2)

5.2   (2)

5.3   (2)

5.4   (2)

5.5   (2)

5.6   (2)

[12]
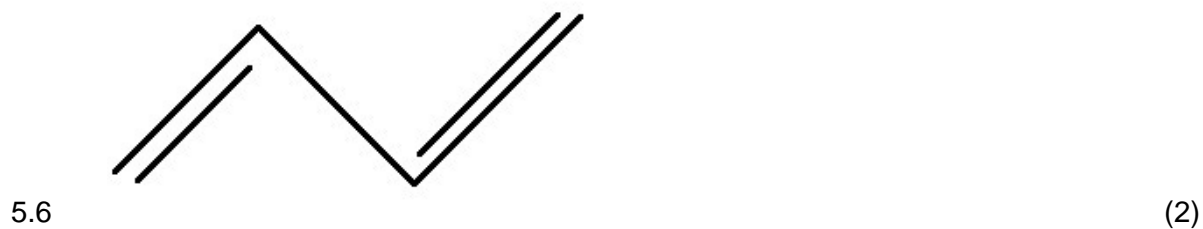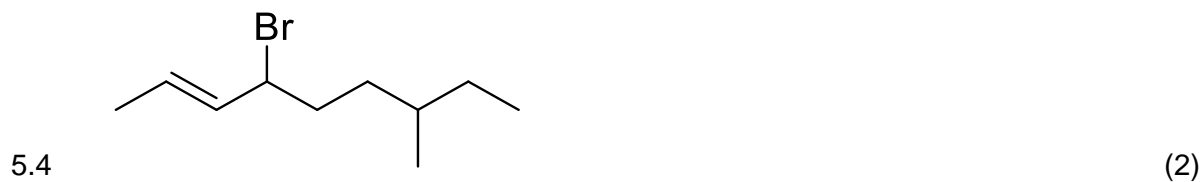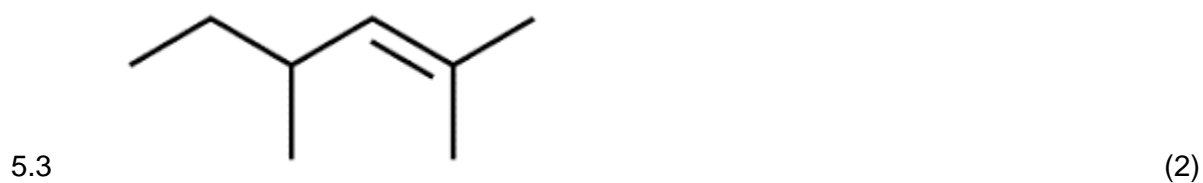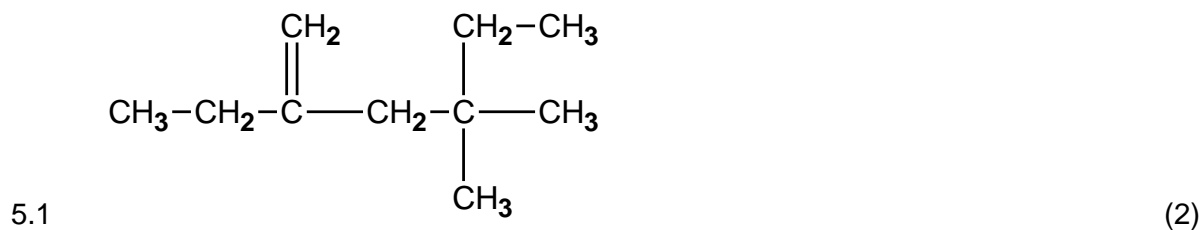
----------------------------END OF QUESTIONS-----------------------------------

DATA SHEET

1 mole of a gas at STP = 22.4 L

Periodic Table

1 H 1.0079																		2 He 4.0026
3 Li 6.941	4 Be 9.0122												5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.179
11 Na 22.990	12 Mg 24.305												13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.064	17 Cl 35.453	18 Ar 39.948
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.88	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39		31 Ga 69.723	32 Ge 72.61	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41		49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59		81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.03	89 Ac 227.03																

Atomic Number — 2 He 4.0026 — Atomic Weight

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm 146.92	62 Sm 150.36	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (234)	96 Cm (247)	97 Bk 247	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)