Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	CHEMISTRY
COURSE CODE	:	DAM 13102
PROGRAMME CODE	:	DAM
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	2 HOURS AND 30 MINUTES
INSTRUCTIONS		1. ANSWER ALL QUESTIONS. 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**. 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA **CLOSED BOOK.**

THIS QUESTION PAPER CONSISTS OF **SEVEN** (7) PAGES

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Q1 (a) Element *X* consists of 38 protons and 50 neutrons.

(i) Determine the atomic number and atomic mass of the element *X*.

(2 marks)

(ii) Write the nuclide symbol for the element *X*.

(2 marks)

(iii) Chromium, Cr, has the following isotopic masses and fractional abundances:

Mass Number	*Isotopic Mass (amu)*	*Fractional Abundance*
50	49.9461	0.0435
52	51.9405	0.8379
53	52.9407	0.0950
54	53.9389	0.0236

Determine the average atomic weight of chromium.

(3 marks)

(b) Write the definitions of heterogenous mixture and homogenous mixture. Give an example for each definition to explain your answer.

(4 marks)

(c) Lead (II) chromate, $PbCrO_4$, is a yellow paint pigment prepared by the precipitation reaction of lead (II) nitrate and potassium chromate solution. In a preparation, 45.6 g of lead (II) chromate is obtained as a precipitate.

(i) Write the molar mass of lead (II) chromate, $PbCrO_4$.

(2 marks)

(ii) Calculate the number of moles of $PbCrO_4$ is produced in the reaction.

(3 marks)

(d) The volatile liquid ethyl mercaptan, C_2H_6S, is one of the most odoriferous substances known. It is sometimes added to natural gas to make gas leaks detectable. Calculate how many C_2H_6S molecules are contained in a 1.0 μL sample. The density of liquid ethyl mercaptan is 0.84 g/mL.

(4 marks)

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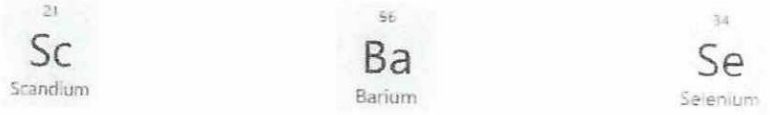
Q2 (a) (i)



Draw the electron diagram of these atoms. Determine which is the largest atom. Justify your answer.

(5 marks)

(ii) Potassium and magnesium are required in our diet. Write the electron configurations of the ions expected from these elements.

(2 marks)

(b) Write the definition of atomic radius and explain the trend within each period and group of the periodic table.

(4 marks)

(c) By referring to the given **List of Chemical Elements,** draw the orbital diagrams for the following elements:

(i) C

(2 marks)

(ii) P

(2 marks)

(iii) V

(2 marks)

(d) In one area of Australia, the cattle did not thrive despite the presence of suitable forage. An investigation showed the cause to be the absence of sufficient cobalt in the soil. Cobalt forms cations in two oxidation states, Co^{2+} and Co^{3+}. Write the electron structure of the two cations.

(3 marks)

Q3 (a) Write a plausible Lewis structure for *cyanogen*, C_2N_2, a poisonous gas used as a fumigant and rocket propellant.

(5 marks)

(b) Draw the Lewis structure for the carbonate ion, CO_3^{2-}. Show all possible resonance structures of carbonate ion. Indicate the formal charge of each atom.

(10 marks)

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(c) Write the definition of resonance. Give an example to justify your answer.

(5 marks)

Q4 (a) (i) State **three** (**3**) properties of gas.

(3 marks)

(ii) In order to describe or discuss the properties of gases, we must know the variables that determine their state. Name the **three** (**3**) variables and their units.

(3 marks)

(b) (i) State Boyle's law.

(2 marks)

(ii) A sample of gas has an initial volume of 5.0 L at a pressure of 2.0 atm. If the pressure is increased to 3.0 atm while the temperature remains constant, calculate the final volume of the gas, according to Boyle's Law.

(5 marks)

(c) (i) State combined gas law.

(2 marks)

(ii) A sample of gas has an initial volume of 4.0 L, a pressure of 1.0 atm, and a temperature of 25°C. If the volume is increased to 6.0 L, the pressure is decreased to 0.5 atm, and the temperature is decreased to 20°C, calculate the initial pressure of the gas according to the combined gas law.

(5 marks)

Q5 (a) (i) Define specific heat, *s*.

(2 marks)

(ii) A metal rod with a mass of 100 g is heated from 20°C to 80°C using 2000 J of energy. Calculate the specific heat capacity of the metal.

(5 marks)

(b) (i) Define enthalpy change.

(2 marks)

(ii) The combustion of 1 mol of methane releases 890.4 kilojoules of heat energy as shown in the following formula. Calculate the ΔH if 32 g of methane is used. Given that the molar mass of methane is 16.04 g/mol.

$$CH_4(g) + 2O_{2(g)} \rightarrow CO_2(g) + 2H_2O_{(l)} \qquad \Delta H = -890.4\text{kJ}$$

(5 marks)

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(c) The following reactions have been studied and their enthalpy changes (ΔH) are known:

$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$	ΔH = -571.6 kJ/mol
$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$	ΔH = -393.5 kJ/mol
$2H_{2(g)} + C(s) \rightarrow CH_{4(g)}$	ΔH = 74.8 kJ/mol

Calculate the enthalpy change (ΔH) for the following reaction:

$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$

(6 marks)

- END OF QUESTIONS -

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List of chemical elements

Atomic No.	*Atomic Weight*	*Name*	*Sym.*	*Atomic No.*	*Atomic Weight*	*Name*	*Sym*
1	1.0	Hydrogen	H	31	69.72	Gallium	Ga
2	4.0	Helium	He	32	72.64	Germanium	Ge
3	6.9	Lithium	Li	33	74.92	Arsenic	As
4	9.0	Beryllium	Be	34	78.96	Selenium	Se
5	10.81	Boron	B	35	79.90	Bromine	Br
6	12.01	Carbon	C	36	83.80	Krypton	Kr
7	14.01	Nitrogen	N	37	85.47	Rubidium	Rb
8	16.00	Oxygen	O	38	87.62	Strontium	Sr
9	19.00	Fluorine	F	39	88.91	Yttrium	Y
10	20.18	Neon	Ne	40	91.22	Zirconium	Zr
11	22.99	Sodium	Na	41	92.91	Niobium	Nb
12	24.31	Magnesium	Mg	42	95.94	Molybdenum	Mo
13	26.98	Aluminum	Al	43	98.00	Technetium	Tc
14	28.09	Silicon	Si	44	101.07	Ruthenium	Ru
15	30.97	Phosphorus	P	45	102.91	Rhodium	Rh
16	32.07	Sulfur	S	46	106.42	Palladium	Pd
17	35.45	Chlorine	Cl	47	107.87	Silver	Ag
18	39.95	Argon	Ar	48	112.41	Cadmium	Cd
19	39.10	Potassium	K	49	114.82	Indium	In
20	40.08	Calcium	Ca	50	118.71	Tin	Sn
21	44.96	Scandium	Sc	51	121.76	Antimony	Sb
22	47.87	Titanium	Ti	52	127.60	Tellurium	Te
23	50.94	Vanadium	V	53	126.90	Iodine	I
24	52.00	Chromium	Cr	54	131.29	Xenon	Xe
25	54.94	Manganese	Mn	55	132.91	Cesium	Cs
26	55.85	Iron	Fe	56	137.33	Barium	Ba
27	58.93	Cobalt	Co	57	138.91	Lanthanum	La
28	58.69	Nickel	Ni	58	140.12	Cerium	Ce
29	63.55	Copper	Cu	59	140.91	Praseodymium	Pr
30	65.39	Zinc	Zn	60	144.24	Neodymium	Nd

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$$pV = nRT$$

$$d = \frac{m}{V}$$

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