ANDERSON SERANGOON JUNIOR COLLEGE
2025 JC 1 H2 CHEMISTRY
TERM 3 LECTURE TEST (WA 2)

26

Duration: 45 min

Name: _____ **Class:** ___ ___ **Date:** **16 July 2025**

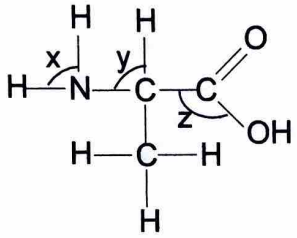
A Data Booklet is provided. Please use it where relevant.

Section A: Multiple–Choice Questions (9 marks)
Write your answers to **Section A** in the following table.

1	2	3	4	5	6	7	8	9

For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider to be correct.

1 Analine is an amino acid and its structure is shown below.



What are the bond angles x, y and z in this structure?

	x	y	z
A	90°	90°	120°
B	104°	90°	117
C	107°	109°	120°
D	120°	109°	120°

2 In which pairs of compounds does the **first** molecule have a net dipole but the **second** molecule have no net dipole?

1 H_2S and $BeCl_2$

2 PF_3 and SO_3

3 CH_3Cl and $SiCl_4$

A 1 ,2 and 3

B 1 and 2

C 2 and 3

D 1 only

3 The table shows the structural formulae and relative molecular masses, M_r, of four compounds.

Compound	E	F	G	H
Structural formulae	$CH_3CH_2CH_3$	$CH_3CH_2CH_2OH$	CH_3CH_2Cl	CH_3CH_2COOH
M_r	44.0	60.0	64.5	74.0

What is the correct order of increasing boiling point of the four compounds?

A E → F → H → G

B G → H → F → E

C E → G → F → H

D E → F → G → H

4 A small spacecraft of capacity 15 m^3 is connected to another spacecraft of capacity 35 m^3. Before connection, the pressure in the smaller spacecraft is 60 kPa and that inside the larger one is 110 kPa.

If all measurements are made at the same temperature, what is the pressure, in kPa, in the two spacecraft after connection?

A 75 kPa

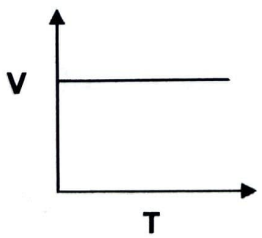
B 77 kPa

C 95 kPa

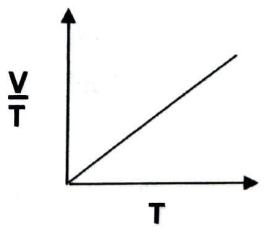
D 170 kPa

5 Which one of the following diagrams correctly describes the behaviour of a fixed mass of an ideal gas at constant pressure (p)?

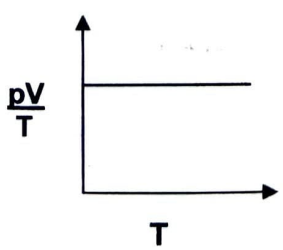
A



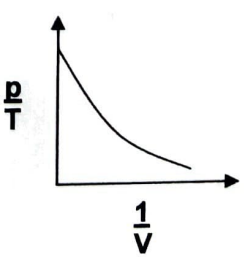
B



C



D



6 Which equation corresponds to the enthalpy change stated?

A	$H_2(g) \longrightarrow 2H(g)$	$\Delta H^{\ominus}_{atomisation}(H_2)$
B	$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$	$\Delta H^{\ominus}_{combustion}(CH_4)$
C	$2CaCl_2(s) + aq \longrightarrow 2Ca^{2+}(aq) + 4Cl^-(aq)$	$\Delta H^{\ominus}_{solution}(CaCl_2)$
D	$H_2SO_4(aq) + 2KOH(aq) \longrightarrow K_2SO_4(aq) + 2H_2O(l)$	$\Delta H^{\ominus}_{neutralisation}$

7 When 120 cm^3 of 0.800 mol dm^{-3} $Pb(NO_3)_2$ and 80 cm^3 of 1.00 mol dm^{-3} KI are mixed together, the temperature changes from 22.8 °C to 26.9 °C.

$Pb(NO_3)_2(aq) + 2KI(aq) \longrightarrow PbI_2(s) + 2KNO_3(aq)$ $\Delta H_{reaction}$

Assume that the specific heat capacity of the solution is 4.18 J g^{-1} K^{-1} and that the density of the solution is 1.00 g cm^{-3}.

What is the enthalpy change for this reaction, $\Delta H_{reaction}$?

A −3.43 kJ mol^{-1}

B −42.8 kJ mol^{-1}

C −85.7 kJ mol^{-1}

D −5790 kJ mol^{-1}

8 Phosphorus pentachloride reacts with limited amount of water to give a liquid and white fumes as shown in the equation below.

$$PCl_5(s) + H_2O(l) \longrightarrow POCl_3(l) + 2HCl(g) \qquad \Delta H^{\ominus}_{reaction} = -640 \text{ kJ mol}^{-1}$$

The following enthalpy changes are given below.

$\Delta H^{\ominus}_{formation}(PCl_5(s)) = -444$ kJ mol^{-1}

$\Delta H^{\ominus}_{formation}(HCl(g)) = -92$ kJ mol^{-1}

$\Delta H^{\ominus}_{combustion}(H_2) = -286$ kJ mol^{-1}

What is the standard enthalpy change of formation of $POCl_3(l)$?

A +94 kJ mol^{-1}

B −900 kJ mol^{-1}

C −1186 kJ mol^{-1}

D −1278 kJ mol^{-1}

9 When water vapour condenses at 100 °C, 40.7 kJ mol^{-1} of heat is evolved.

What is the entropy change when 54 g of water vapour condenses at 100°C.

A $-109\ J\ K^{-1}$

B $-327\ J\ K^{-1}$

C $+109\ J\ K^{-1}$

D $+327\ J\ K^{-1}$

Section B: Structured Questions (17 marks)

Answer all questions in **Section B** in the space provided. You may lose marks if you do not show your working or if you do not use appropriate significant figures or units.

1 (a) (i) Draw the "dot-&-cross" diagram and suggest the shape of $AlBr_3$.

dot-and-cross diagram:

shape:

[2]

(ii) Like $AlCl_3$, $AlBr_3$ can undergo dimerisation as well.

Using VSEPR theory, explain the change in bond angle when $AlBr_3$ dimerises to form Al_2Br_6, by considering the changes in the number, and type of electron pairs around the central Al atom.

....[2]

(b) Account for the difference in melting points between the following substances in terms of structure and bonding.

compound	melting point / °C
$SOCl_2$	−105
Si	1414

....[2]

(c) SO_2 behaves more like an ideal gas under certain conditions.

(i) State the **properties** of a gas necessary for it to approach ideal behaviour.

.....[2]

(ii) A sample of SO_2 gas was placed in a container at 30 °C at a pressure of 151 kPa. Assuming ideal gas behaviour, determine the density, in g m^{-3}, of the gas in the container.

[1]

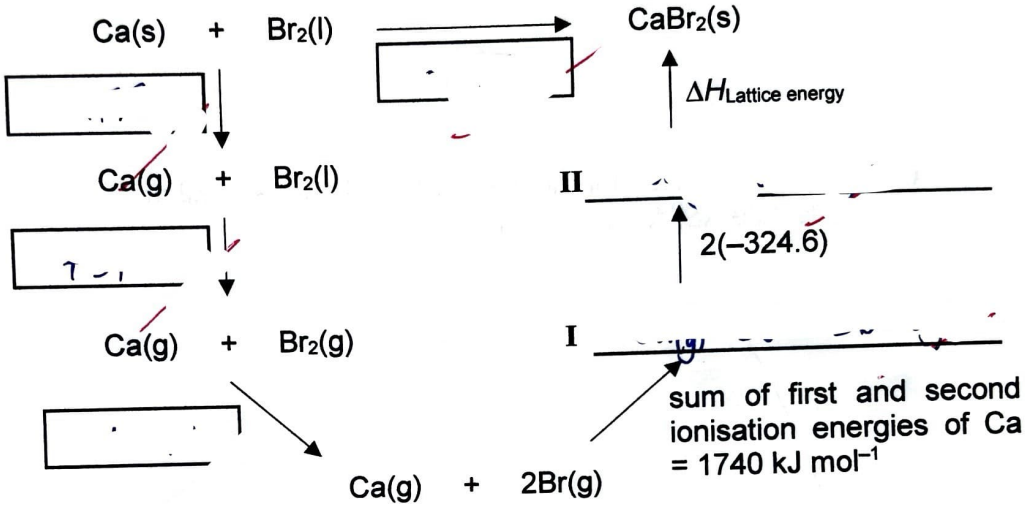
[Total: 9]

2 **(a)** **(i)** Using the data in Table 2.1, and relevant data from the *Data Booklet*, complete the Born-Haber cycle provided by filling in:

- the values of the enthalpy changes of the various reactions, and
- the species involved for **I** and **II**.

Table 2.1

	value / kJ mol^{-1}
electron affinity of bromine	–324.6
enthalpy change of vaporisation of bromine	+31.0
standard enthalpy change of atomisation of Ca(s)	+178
standard enthalpy change of formation of $CaBr_2$(s)	–675



[2]

(ii) Hence, calculate a value for the lattice energy of $CaBr_2$.

[1]

(iii) Explain how you would expect the lattice energy of $CaCl_2$ to compare with that of $CaBr_2$.

....[2]

(b) The Sabatier reaction is the catalytic reduction of carbon dioxide to produce methane.

$$CO_2(g) + 4H_2(g) \longrightarrow CH_4(g) + 2H_2O(g)$$

(i) Using bond energies given in the *Data Booklet*, calculate the standard enthalpy change for the Sabatier reaction.

[1]

(ii) The value of $\Delta G_r^{\ominus}$ for the Sabatier reaction is –84 kJ mol^{-1}.
Calculate $\Delta S_r^{\ominus}$ for the reaction.

[1]

(iii) With reference to the chemical equation of the Sabatier reaction, explain the sign of $\Delta S_r^{\ominus}$ obtained in **(ii)**.

.....

.....[1]
[Total: 8]

END