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Colombo 07 Royal College

First Term Test November – 2018
Year 12

රසායන විද්‍යාව I
Chemistry I

02 E I

පැය එකයි
One hour

- This paper consists of 04 pages.
- Answer all the questions.
- Use of calculators is not allowed.
- Write your Index Number in the space provided in the answer sheet.
- In each of the questions 1 to 25, pick one of the alternatives from (1), (2), (3), (4), (5) which is correct or most appropriate and mark your response on the answer sheet with a cross (X) in accordance with the instructions given on the back of the answer sheet.

Universal gas constant $R = 8.314\ J\ K^{-1}\ mol^{-1}$
Avogadro constant $N_A = 6.022 \times 10^{23}\ mol^{-1}$
Planck's constant $= 6.626 \times 10^{-34}\ J\ s$
Velocity of light $= 3 \times 10^{8}\ m\ s^{-1}$

Answer all the questions.

01) When the principle quantum number (n) and the azimuthul quantum number (l) are considered, what is the maximum number of electrons that can exist in accordance with $n + l \leq 3$.

1) 6 2) 8 3) 10 4) 12 5) 18

02) Which of the following has the longest wave length.

1) Radio waves
2) X - rays
3) Infra red radiation
4) Ultra violet radiation
5) Gamma rays

03) The mass percentage of Cl in the tetrachloride of M is 86%. The relative atomic mass of M is (Consider that the relative atomic mass of chlorine is 36)

1) 12 2) 24 3) 36 4) 48 5) 60

04) Which of the following has the highest second ionization energy?

1) Mg 2) Al 3) Be 4) B 5) Ar

05) When 39 g of $MgCO_3.\ xH_2O$ is heated the mass of MgO formed was 10 g. What is the value of X?
(Mg = 24, O = 16, C = 12)

1) 2 2) 4 3) 5 4) 7 5) 8

06) What is the concentration of Na^+ in the $200\ cm^3$ solution prepared by dissolving 6.7 g of pure $Na_2C_2O_4$ in water. (Na – 23, C – 12 O – 16)

1) 0.025 2) 0.05 3) 0.10 4) 0.25 5) 0.50

07) The mass of the solid residue obtained when 67 g of a solid mixture containing $CaCO_3$ (s) and $MgCO_3$(s) in the mole ratio 1 : 2, is thermally decomposed is,
(Ca – 40, Mg – 24, C – 12, O – 16)

$$CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$$
$$MgCO_3(s) \longrightarrow MgO(s) + CO_2(g)$$

1) 9.6 g 2) 23 g 3) 34 g 4) 38 g 5) 58 g

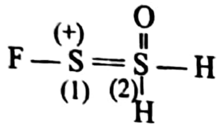
08) MO_4^{n-} ions are reduced to M^{2+} in acid medium. When one mole of MO_4^{n-} is reduced, four moles of I^- ions are oxidized to I_2. The value of n is,

1) 1 2) 2 3) 3 4) 4 5) 5

09) 40 g of SO_2 contains in 10 m^3 of a gas mixture having the density of 0.2 g cm^{-3}. What is the content of SO_2 in ppm.

1) 100 2) 200 3) 300 4) 400 5) 500

10)



$$F-\overset{(+)}{\underset{(1)}{S}}=\overset{O}{\underset{\underset{H}{|}}{\overset{\|}{S}}}-H$$

Oxidation numbers of the S atoms labelled as (1) and (2) in above structure are,

1) +2 and 0 2) +1 and 0 3) +3 and +4 4) +2 and +4 5) +4 and +6

11) Dry mass of AgCl precipitate formed when excess of $AgNO_3$ solution was added to 200 cm^3 of an aqueous solution which contains only $NaNO_3$ and NaCl in 1 : 2 molar ratio was 5.74 g. What is the concentration of $NaNO_3$ in the initial solution in mol dm^{-3} (Ag – 108, Cl – 35.5)

1) 0.1 2) 0.2 3) 0.4 4) 0.01 5) 0.02

12) 20 cm^3 of 0.02 $moldm^{-3}$ $K_2Cr_2O_7$ solution required to react completely with 50 cm^3 of acidified $FeSO_4$ solution. What is the concentration of $FeSO_4$ in $moldm^{-3}$?

$$Fe^{2+} \longrightarrow Fe^{3+}$$
$$Cr_2O_7^{2-} \longrightarrow Cr^{3+}$$

1) 0.001 2) 0.008 3) 0.048 4) 0.08 5) 0.48

13) A certain vessel contains equal masses of two gases A and B. The relative molecular mass of A is three times that of B. The total pressure of the mixture is 4×10^5 Pa. What is the partial pressure of B.

1) $\frac{1}{3} \times 10^5$ Pa 2) $\frac{1}{4} \times 10^5$ Pa 3) $\frac{3}{4} \times 10^5$ Pa
4) 1×10^5 Pa 5) 3×10^5 Pa

14) The gas A exists in a vessel of volume 2V at 127 °C and 2×10^5 Pa pressure. The gas B exists in a vessel of volume V at 227 °C and 4×10^5 Pa. pressure. The mole ratio of two gases. ($n_A : n_B$) is

1) 4 : 5 2) 5 : 4 3) 2 : 5 4) 5 : 2 5) 5 : 8

15) When a 20 cm^3 of a certain hydrocarbon is completely burnt in excess of oxygen, the volumes of $H_2O(g)$ and $CO_2(g)$ formed were 40 cm^3 and 20 cm^3 respectively. What was the volume of O_2 in cm^3, used for the reaction if all volumes were mesured under the same condition.

1) 20　2) 30　3) 40　4) 50　5) 60

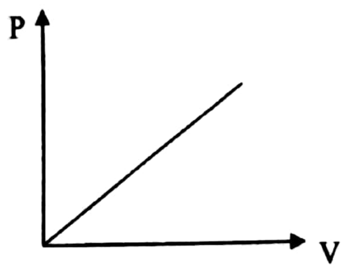
- For each of the questions 16 to 20, one or more responses out of the four responses (a), (b), (c) and (d) given is/are correct. Select the correct response/responses. In accordance with the instructions given on your answer sheet, mark

(1) If only (a) and (b) are correct
(2) If only (b) and (c) are correct
(3) If only (c) and (d) are correct
(4) If only (d) and (a) are correct
(5) If any other number or combination of responses is/are correct.

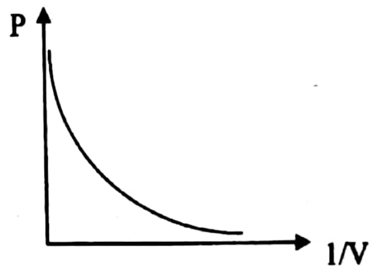
Summary of above instructions				
1	2	3	4	5
Only (a) and (b) correct	Only (b) and (c) correct	Only (c) and (d) correct	Only (d) and (a) correct	Any other response or combination of responses correct

16) Which of the following graph / graphs are correct when a constant mass of an ideal gas is considered,

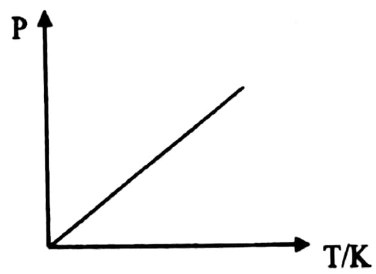
a) at constant temperature



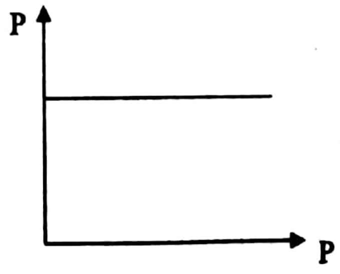
b) at constant temperature



c) at constant pressure



d) $\frac{PV}{T}$



17) Which of the following is/are true regarding a sp^2 hybridized atom?
a) the shape around the atom could be angular
b) the shape around atom could be trigonal pyramidal
c) π bond/s must be connected to the atom.
d) when there are more than one σ bonds, the bond angle around the atom is greater than 100°

18) A particular $250\ cm^3$ aqueous solution of NH_4NO_3 contains 100 g of NH_4NO_3 dissolved in it. Which of the following is/are true about this solution? Density of the solution is 1.2 g cm^3.
(N – 14, O – 16, H – 1)
a) The molarity of NH_4NO_3 is 5 mol dm^{-3}
b) The molality of NH_4NO_3 is 6.25 mol kg^{-1}.
c) Percentage of NH_4NO_3 by mass is 40%
d) Percentage of oxygen by mass is is 20%

19) Which of the following species exists /exist as a lattice at room temperature?
a) Hg b) K_2O c) SiO_2 d) coke

20) Which of the following is true regarding the $^{208}_{82}Pb^{2+}$ ion?
a) It contains equal number of electrons and neutrons.
b) It contains an equal number of electrons and protons.
c) the no of neutrons if it is, 126
d) the no of electrons in it is, 80

- In question no. 21 to 30, two statements are given in respect of each question. From the table given below, select the response out of the responses (1), (2), (3), (4) and (5) that best fits the two statements and mark appropriately on your answer sheet.

Response	first statement	second statement
(1)	True	true and correctly explain the first statement
(2)	True	true, but does not explain the first statement correctly
(3)	True	False
(4)	False	True
(5)	False	False

	First statement	Second statement
21)	Always, when the absolute temperature of a fixed mass of an ideal gas is doubled, its pressure is also doubled.	The pressure of a fixed mass of an ideal gas is directly proportional to its absolute temperature.
22)	The boiling point of HF is greater than HCl.	The H – F bond is stronger than the H – Cl bond.
23)	The 2nd ionization energy of Na is greater than the 2nd ionization energy of Mg.	The effective nuclear charge of Na^+ is greater than that of Mg^{2+}.
24)	The NH_4^+ ion has a dipole moment.	One bond of NH_4^+ should be a dative bond.
25)	The gap between first line (least frequency) and the second line in Lyman series of the emission spectrum of hydrogen is greater than that of Balmer series.	The gap between first and second energy levels of hydrogen atom is greater than that between second and third energy levels.

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First Term Test November 2018

Grade 12

රසායන විද්‍යාව II
Chemistry II

02 E II

පැය 1 ½
1 ½ hours

Name:.. Index No. .... Class : ....

- Use of calculators is not allowed.
- Universal gas constant R = 8.314 $JK^{-1} mol^{-1}$
- Avogadro constant N_A = $6.022 \times 10^{23} mol^{-1}$
- Plank constant h = 6.626×10^{-34} Js
- Velocity of light C = $3.0 \times 10^{8} ms^{-1}$

Part A – Structured Essay (pages 2 – 5)

- Answer all the questions on the question paper itself.
- Write your answer in the space provided for each question. Please note that the space provided is sufficient for the answer and that extensive answers are not expected.

Part B Essay (pages 6 – 7)

- Answer both questions
- At the end of the time allotted for this paper, tie the answers to the two Parts A, B together so that Part A is on top and hand them over to the Supervisor.
- You are permitted to remove only Parts B of the question paper from the Examination Hall.

For Examiner's Use Only

Paper I	
Paper II	
Total	
Percentage	

Final Marks	

Part	Question NO	Marks
A	1	
	2	
B	3	
	4	
Total		
Percentage		

Part A – Structured Essay

Answer all the questions on this paper itself. Each question carries 100 marks

(1) a) Arrange the given species in the ascending order of the property stated in parenthesis.

(i) O^{2-}, Ne, Al^{3+} (radius)

_____ < _____ < _____

(ii) CH_4, H_2S, ICl_4^- (bond angle)

_____ < _____ < _____

(iii) NH_3, HF, HCl (boiling point)

_____ < _____ < _____

(iv) CO_2, CO, CO_3^{2-} (bond length of C – O bond)

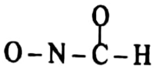
_____ < _____ < _____

(v) NH_3, NH_4^+, NO_2^+ (electronegativity of N atom)

_____ < _____ < _____

(25 Marks

b) The atomic skeleton of the molecule $HCNO_2$ is given below.



$$O - N - \overset{O}{\overset{|}{C}} - H$$

i) Draw all the possible resonance structures for the above structure and label them as A, B, C etc.

ii) Of the above structures, which is the most stable structure?

iii) State the reasons separately for the relative instability of each of the resonance structures in comparison to the structure in part (ii).

....

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R

iv) Complete the following table considering the most stable structure mentioned in ii).

Atom	The electron pair geometry around the atom	Hybridization	Shape	Oxidation number
N				
C				

v) Sketch the shape of the above molecule giving the approximate bond angles.

(45 Marks)

C) Consider the compounds CCl_4, NH_3, NaCl and NaF, fill in the blanks of the following paragraphs.

Other terms that must be used.

(Relative molecular mass, C – Cl, N–H, surface area, H bonds, London forces, ionic lattices, large, smaller , polarizability, polarizing power, ion – dipole, interactions)

Out of the above compounds, ………………… and NH_3 exist as molecules. Out of those two ……………… is a polar molecule and there are …………………. between those molecules. Even though…………….. bond is a polar covalent bond, ……………. is a non – polar molecule. Therefore only ………………………………. are there between molecules.

The ……………………………. and the ……………………………. of CCl_4 molecule is relatively large causing the inter – molecular attractive forces to be more stronger. As a result of this, ……………………..is a liquid at room temperature while ……………….. is a gas.

NaCl and NaF exist as ………………………………. Since radius of Cl^- is …………………than that of F^-,………………………… of Cl^- is greater. Therefore, the ionic character of …………………….. is relatively large. The secondary interactions formed when these compounds are dissolved in water is …………………………..

(30 Marks)

(2) a) a) $Na_2C_2O_4$ is considered as a "primary standard"

i) State two main characteristics of a "primary standard"

....

....

ii) A 250 cm^3 of 0.1 $moldm^{-3}$ $Na_2C_2O_4$ solution to be prepared using pure $Na_2C_2O_4$ powder.

I. Underline the glassware and equipment needed to prepare the above solution from the lis given bellow.

- Four beam balance
- 250 cm^3 volumetric flask
- watch glass
- wash bottle
- 250cm^3 measuring cylinder
- 250cm^3 titrimetric flask.
- Burette

(Note : marks will be deducted for each wrong selection)

II. Calculate the mass of pure $Na_2C_2O_4$ needed to prepare the above solution.
(Na – 23, C – 12, O – 16)

....

....

....

....

....

(35 Marks)

b) The experimental procedure used to determine the concentration of a $KmnO_4$ solution using th $Na_2C_2O_4$ solution prepared in part (a) is given below.

- 25.00 cm^3 of the $Na_2C_2O_4$ solution was acidified with dill H_2SO_4 acid and warmed. Then it wa titrated with the given $KmnO_4$ solution.

i) State the glassware / apparatuses that must be used to measure each of the followin solutions.

I. dil. H_2SO_4 solution- ....

II. $Na_2C_2O_4$ solution - ....

III. $KmnO_4$ solution - ....

ii) What is the colour change at the end point?

....

iii) Write the balanced chemical equations for the following reactions related to the above titration.

I. Oxidation half reaction.

....

II. Reduction half reaction.

....

III. Overall ionic reaction.

....

(40 Marks)

c) 5.0 g of a solid mixture which is only consisted of Na_2CO_3 and $Na_2C_2O_4$ was dissolved in water to prepare a 250 cm^3 solution . 25.00 cm^3 of 0.025 $moldm^{-3}$ $KmnO_4$ solution was required to react completely with 25.00 cm^3 of the above solution mixture in an acidic medium.

(Na – 23, O – 16, C – 12)

ii) What is the number of moles of MnO_4^- moles reacted?

....

....

ii) What is the mass of $Na_2C_2O_4$ in the initial mixture?

....

....

....

....

ii) Calculate the number of moles of Na_2CO_3 in the initial mixture?

....

....

....

....

(25 Marks)

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First Term Test November 2018

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Chemistry II

02 E II

Part B – Essay

Answer all the question. Each question carries 150 marks

(3) a) i) Complete the table given below after copying it into your answer script.

	Species	Electron pair geometry (A)	Shape (B)	Mark whether presence (✓) or absence (X) of a net dipole moment (C)
I	SF_4			
II	ClF_4^-			
III	NH_2^-			
IV	NO_3^-			
V	ICl_2^-			

ii) Explain reasons for the following observations.

I. The melting point of Ca is greater than that of K.

I) The melting points of the compounds NaF, NaCl and NaBr varies in the order of NaF > NaCl > NaBr.

II) First ionization energy of Be is greater than that of B.

III) The ionic radius of N^{3-} is greater than the atomic radius of Ne.

(70 Marks)

b) Balance the chemical equations that are given below.

i) $C + H_2SO_4 \longrightarrow CO_2 + SO_2 + H_2O$

ii) $SnO_2 + HI \longrightarrow SnI_2 + I_2 + H_2O$

iii) $KOH + KNO_3 + Zn \longrightarrow K_2ZnO_2 + NH_3 + H_2O$

iv) $H_2SO_4 + Na_2Cr_2O_7 + NaBr \longrightarrow Cr_2(SO_4)_3 + Br_2 + Na_2SO_4 + H_2O$

(40 Marks)

c) When 6.36 g of a solid mixture of $(NH_4)_2Cr_2O_7$ and $(NH_4)_2CO_3$ only, was subjected decomposition by heat, the mass loss was 4.84 g. (N – 14, Cr – 52, O – 16, H - 1)

$(NH_4)_2Cr_2O_7(s) \longrightarrow Cr_2O_3(s) + N_2(g) + 4\ H_2O\ (g)$

$(NH_4)_2CO_3(s) \longrightarrow 2NH_3(g) + CO_2(g) + H_2O(g)$

iii) Calculate the number of moles of each component in the initial mixture.

iv) Calculate the total mass of H_2O evolved.

(40 Mark

4) a) i) State Charles's law in words.

ii) Starting from the ideal gas equation, derive an expression for the Charles's law.

iii) Volume of a constant mass of a gas at 127°C temperature was increased by 20% under constan pressure. What is the new temperature of the gas in degree Celsius?

iv) At 27°C, 0.25 mol of a certain gas is in a closed vessel having a volume of $4.157 dm^3$. Calculate pressure of the gas.

v) A mixture of gases containing Ne and N_2 only are in a vessel having a fixed volume of $V dm^3$. The total pressure of the gas mixture at 27°C temperature was 1.5×10^5 Pa.
After adding **excess** of heated Mg, the temperature was increased up to 227°C. Then the following reaction took place inside the vessel.
$3Mg(s) + N_2(g) \longrightarrow Mg_3N_2(s)$
The mass of the $Mg_3N_2(s)$ formed (negligible volume) was 20 g. The new pressure inside the vessel at 227°C temperature remained at 1.5×10^5 Pa.
(Mg – 24, N – 14, Ne – 20)

i) Calculate the number of moles of Mg_3N_2 formed.

ii) What is the number of moles of N_2 in the initial mixture?

iii) Calculate the partial pressures of Ne and N_2 gasses at 27°C temperature separately.

iv) What is the total mass of the initial gas mixture at the beginning?

(100 Marks)

b) 0.246g of a solid mixture consisted of Na_2SO_3 and Na_2SO_4 only, was dissolved completely in 100 cm^3 solution of $0.01\ moldm^{-3}$ I_2 (in KI).
$(SO_3^{2-} + I_2 \longrightarrow SO_4^{2-} + I^-)$
A $40cm^3$ volume of Na_2SO_3 solution having a concentration of $0.02\ moldm^{-3}$ was required to react completely with the remaining I_2. Calculate the number of moles of each components in the initial solid mixture.
(Na – 23, S – 32, O – 16)
$(S_2O_3^{2-} + I_2 \longrightarrow S_4O_6^{2-} + I^-)$

(50 Marks)

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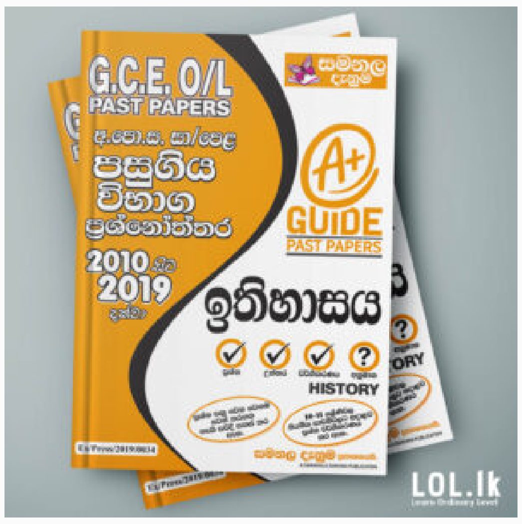

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