Second Semester

Chemistry

(الكيمياء)

(Answers)

مركز القياس والتقويم التربوي
The Center for Educational Assessment and Measurement (CEAM)

سلطنة عمان
وزارة التربية والتعليم

MARKING GUIDE

GENERAL EDUCATION DIPLOMA

BILINGUAL PRIVATE SCHOOLS

SEMESTER TWO - FIRST SESSION

CHEMISTRY

2022 / 2023

General Education Diploma, Semester Two, First Session
Bilingual Private Schools, Chemistry, 2022/2023

Exam Specifications:

Topics of the units	Weighting %	Multiple choice (20%)					Extended response (80%)					Total
		No. of Items	Cognitive levels			Marks	No. of questions	Marks	Cognitive levels			
			Knowledge (30%)	Application (50%)	Reasoning (20%)				Knowledge (30%)	Application (50%)	Reasoning (20%)	
An introduction to the chemistry of transition elements	23%	3	1	1	1	3	10	14	4	7	3	17
Reaction Kinetics	19%	3	1	2	-	3		10	3	5	2	13
Equilibria	29%	4	1	2	1	4		16	5	8	3	20
Electrochemistry	29%	4	1	2	1	4		16	5	8	3	20
Total	100%	14	4	7	3	14		56	17	28	11	70

Distribution of cognitive domains and marks.

Item	Mark	Unit	Cognitive domain	Output
1	1	An introduction to the chemistry of transition elements	Knowledge	6.2.a
2	1	An introduction to the chemistry of transition elements	Application	6.2.b
3	1	An introduction to the chemistry of transition elements	Reasoning	6.2.b, 6.2.d
4	1	Quantitative Kinetics	Application	7.1.a
5	1	Quantitative Kinetics	Application	7.1.j
6	1	Quantitative Kinetics	Knowledge	7.1.f
7	1	Quantitative Equilibria	Knowledge	8.1.c
8	1	Quantitative Equilibria	Application	8.1.m
9	1	Quantitative Equilibria	Application	8.1.j
10	1	Quantitative Equilibria	Reasoning	8.1.f
11	1	Electrochemistry	Knowledge	9.1.d
12	1	Electrochemistry	Application	9.1.d
13	1	Electrochemistry	Application	9.1.m,o
14	1	Electrochemistry	Reasoning	9.1.p
15a	1	An introduction to the chemistry of transition elements	Knowledge	6.2.a
15b	1	An introduction to the chemistry of transition elements	Knowledge	6.2.c
15c	2	An introduction to the chemistry of transition elements	Application	6.2.b, 6.2.d
16a	2	An introduction to the chemistry of transition elements	Application	6.1.c
16b	2	An introduction to the chemistry of transition elements	Application	6.2.d
16c.i	2	An introduction to the chemistry of transition elements	Reasoning	6.1.g
16.c.ii	1	An introduction to the chemistry of transition elements	Reasoning	6.2.a, 6.2.b
16d	1	An introduction to the chemistry of transition elements	Knowledge	6.2.f
16e.i	1	An introduction to the chemistry of transition elements	Application	6.2.e
16.e.ii	1	An introduction to the chemistry of transition elements	Knowledge	6.2.d
17.a	1	Reaction kinetics	Knowledge	7.1.a
17.b	1	Reaction kinetics	Knowledge	7.1.a

17.c	2	Reaction kinetics	Application	7.1.f
18.a	2	Reaction kinetics	Application	7.1.f
18.b	1	Reaction kinetics	Application	7.1.f
18.c	2	Reaction kinetics	Reasoning	7.1.b, 7.1.j
18.d	1	Reaction kinetics	Application	7.1.k
19.a	1	Quantitative Equilibria	Application	8.1.i
19.b.i	1	Quantitative Equilibria	Application	8.1.e
19.b.ii	3	Quantitative Equilibria	Application	8.1.h
20.a	2	Quantitative Equilibria	Knowledge	8.1.j
20.b	2	Quantitative Equilibria	Knowledge	8.1.j
20.c	1	Quantitative Equilibria	Reasoning	8.1.k
21.a	2	Quantitative Equilibria	Reasoning	8.1.l,m
21.b.i	1	Quantitative Equilibria	Knowledge	8.1.l
21.b.ii	3	Quantitative Equilibria	Application	8.1.n
22.a	2	Electrochemistry	Knowledge	9.1.i
22.b	1	Electrochemistry	Knowledge	9.1.j
23.a	1	Electrochemistry	Knowledge	9.1.f
23.b	1	Electrochemistry	Application	9.1.g
23.c.i	1	Electrochemistry	Knowledge	9.1.f
23.c.ii	1	Electrochemistry	Application	9.1.f
23.d	1	Electrochemistry	Application	9.1.g
23.e	2	Electrochemistry	Application/ Reasoning	9.1.m
23.f	1	Electrochemistry	Application	9.1.n
23.g	1	Electrochemistry	Application	9.1.o
24.a	2	Electrochemistry	Application	9.2.a
24.b.i	1	Electrochemistry	Reasoning	9.2.a

مركز القياس والتقويم التربوي
The Center for Educational Assessment and Measurement (CEAM)

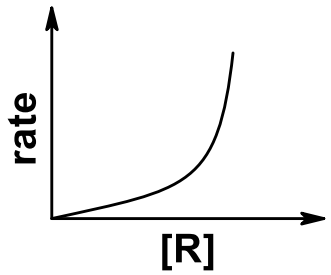
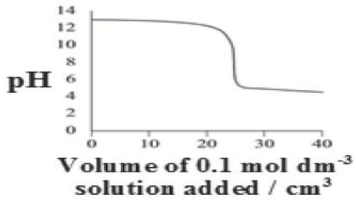
نموذج إجابة امتحان دبلوم التعليم العام

للعام الدراسي: ١٤٤٤هـ - ٢٠٢٢/٢٠٢٣م
الدور: الأول - الفصل الدراسي: الثاني
المادة: الكيمياء الثنائي

سلطنة عمان
وزارة التربية والتعليم

تنبيه: نموذج الإجابة فى (٤) صفحات

There are 14 multiple-choice items. Each correct answer is worth ONE mark.

Item	Correct option	
1	**C**	Transition metals display variable oxidation states.
2	**C**	$[Cu(H_2O)_4(OH)_2]^x$
3	**D**	+3
4	**B**	1
5	**A**	0.00678
6	**C**	
7	**B**	$[H_3O^+]$ and $[OH^-]$ are equal
8	**C**	$H^+(aq)$ in the acid combine with OH^- to make H_2O
9	**B**	 b
10	**A**	**A**
11	**A**	**gain electrons lose electrons**
12	**B**	**HCl**
13	**A**	**increase decrease 0.19**
14	**C**	**Y^{2+}/Y X^{2+}/X Z^{2+}/Z**

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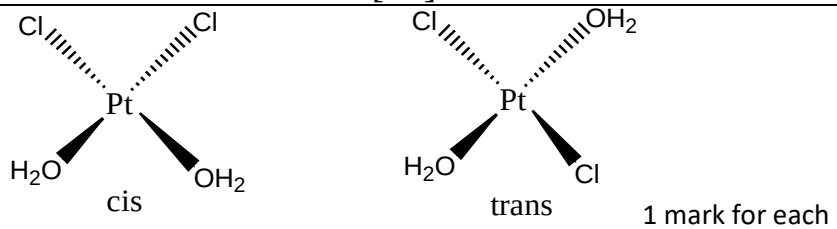
Question Two (56 Marks)

Part	***Section***	***The answer***	***The mark***
15	a	A central transition metal ion surrounded by ligands, bonded to the central ion by dative (also called co-ordinate) covalent bonds.	**1**
	b	Because transition metal ions are relatively small and have a high charge density or they have d orbitals of low energy "partially filled d orbital" that can accommodate electrons donated by the ligands.	**1**
	c	Oxidation state of cobalt=+3, Co-ordination number= 6	**2**
16	a	Nickel ion: $3d^8$ or d^8 or $[Ar]3d^8$ Cobalt ion: $3d^7$ or d^7 or $[Ar]3d^7$	**2**
	b	 1 mark for each	**2**
	c.i.	Bidentate Because each ligand is bonded by two bonds to the metal OR Each ligand is attached to the metal ion by two coordinate bonds OR each ligand contains two lone pairs of electrons OR ligands have two donor atoms which allow them to bind to the central metal atom	**2**
	c.ii.	12 electrons or 6 pairs of electrons	**1**
	d	Pink	**1**
	e.i	$[Co(H_2O)_6]^{2+} + 2OH^- \rightarrow [Co(H_2O)_4(OH)_2] + 2H_2O$	**1**
	e.ii	Octahedral	**1**
17	a	An equation showing the relationship between the rate constant and the concentrations of the species that affect the rate of the reaction.	**1**
	b	The time taken for the amount (or concentration) of the limiting reactant in a reaction to decrease to half its initial value.	**1**
	c	First order Because the reaction has a constant half-life	**2**
18	a.	$[NO_2(g)]$ = first order reaction $[O_3(g)]$ = first order reaction	**1** **1**
	b	$R = k [NO_2] [O_3]$	**1**
	c	$R = k [NO_2] [O_3]$ $10.9 \times 10^{-6} = k [0.5] [1.25]$ $k = 1.74 \times 10^{-5}\ mol^{-1}dm^3s^{-1}$ If a student gets the final value without writing the rate law or substitution 2 marks are given. -Units are not necessary. - Any final value with different scientific notation is acceptable and a full mark is given	**2**
	d	constant	**1**

Part	***Section***	***The answer***	***The mark***
19	**a**	HCN	1 mark
	b.i	$K_a = \frac{[H^+][HCOO^-]}{[HCOOH]}$	1 mark
	b.ii	$K_a = \frac{[H^+][HCOO^-]}{[HCOOH]}$ $1.6 \times 10^{-4} = \frac{[x][x]}{[0.08]}$ OR $[H^+] = \sqrt{(K_a \times C)}$ (1) $[H^+] = 3.577 \times 10^{-3}$ mol dm^{-3} (1) pH= - log $[H^+]$ = 2.446 (1)	3 marks

Part	***Section***	***The answer***	***The mark***
20	**a**	-Titration curve A: Strong acid – Strong base (alkali) -Titration curve B: Weak acid– Strong base (alkali)	2
	b	-Titration curve A: 7.0 ± 1 -Titration curve B: 9.0 ± 1	2
	c	Because its color change pH range is covered by the steep portion of the titration. Or corresponds to the sharp pH change.	1
21	**a**	B Solution B shows a small change in pH when a small amount of acid or base is added to the solution. OR Solution B resists a huge change in pH when a small amount of acid or base is added to the solution.	2
	b.i	A solution whose pH remains nearly constant on the addition of small quantities of acid or base. ***(any meaning gives similar definition which indicates pH is not changing a full mark is given)**	1
	b.ii	$K_a = \frac{[H^+][A-]}{[HA]}$ After mixing the volume is 2.0 dm^3 , so [HA] = 0.10 mol dm^{-3} and $[A-]$ = 0.10 mol dm^{-3} $1.6 \times 10^{-4} = \frac{[H^+](0.10)}{(0.10)}$ (1)	3

		$[H^+] = 1.6 \times 10^{-4}$ mol dm^{-3} (1) pH= - log $[H^+]$ = 3.80 (1) OR pH = pK_a + log $(\frac{[A-]}{[HA]})$ = - log (1.6×10^{-4}) + log $(\frac{(0.10)}{(0.10)})$ = 3.80	

Part	***Section***	***The answer***	***The mark***
22	a	Temperature of 25 °C (298 K), 1 mark Pressure of 1 atmosphere(101 kPa) 1 mark	2
	b	H^+	1
23	a	The salt bridge	1
	b	$Mg(s) \longrightarrow Mg^{2+}(aq) + 2e^-$	1
	c.i	Platinum Or Pt or an inert electrode	1
	c.ii	1.00 mol dm^{-3}	1
	d	The electrons move in the external circuit from the Mg^{2+} / Mg half-cell to the Fe^{3+} / Fe^{2+} half-cell.	1
	e	The magnesium electrode decreases in mass. 1 mark Because the magnesium goes into a solution as magnesium ions or Mg is oxidized or Mg loses electrons. 1 mark	2 marks
	f	Mg(s) | $Mg^{2+}(aq)$ ⁞ $Fe^{3+}(aq)$, $Fe^{2+}(aq)$ | Pt	1 mark
	g	$E^{\theta}_{cell} = E^{\theta}(Fe^{3+}/Fe^{2+}) - E^{\theta}(Mg^{2+}/Mg) = +0.77 - (-2.38) = \underline{3.15V}$	1 mark

Part	***Section***	***The answer***	***The mark***
24	a	OH^- or hydroxide ion H^+, hydrogen ion	1 mark 1 mark
	b	Oxygen or (O_2), which bubbles off at the anode. Hydrogen or (H_2), which bubbles off at the cathode. **- If the half equations are written a full mark is given.**	1 mark 1 mark

This is the end of the Marking Guide

MARKING GUIDE

GENERAL EDUCATION DIPLOMA

BILINGUAL PRIVATE SCHOOLS

SEMESTER TWO - SECOND SESSION

CHEMISTRY

2022 / 2023

Exam Specifications:

General Education Diploma, Semester Two, Second Session
Bilingual Private Schools, Chemistry, 2022/2023

Topics of the units	Weighting %	Multiple choice (20%)					Extended response (80%)					Total
		No. of Items	Cognitive levels			Marks	No. of questions	Marks	Cognitive levels			
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Reaction Kinetics	19%	3	1	2	-	3		10	3	5	2	13
Equilibria	29%	4	1	2	1	4		16	5	8	3	20
Electrochemistry	29%	4	1	2	1	4		16	5	8	3	20
Total	100%	14	4	7	3	14		56	17	28	11	70

General Education Diploma, Semester Two, Second Session
Bilingual Private Schools, Chemistry, 2022/2023

Distribution of cognitive domains and marks.

Serial No	Question number	Item	Mark	Unit	Cognitive domain	Output
1	1	1	1	An introduction to the chemistry of transition elements	Knowing	6.2.a
2	1	2	1	An introduction to the chemistry of transition elements	Applying	6.2.g
3	1	3	1	An introduction to the chemistry of transition elements	Reasoning	6.2.d
4	1	4	1	Quantitative Kinetics	Knowing	7.1.f,g
5	1	5	1	Quantitative Kinetics	Applying	7.1.e
6	1	6	1	Quantitative Kinetics	Applying	7.1.g,i
7	1	7	1	Quantitative Equilibria	Knowing	8.1.c
8	1	8	1	Quantitative Equilibria	Applying	8.1.k
9	1	9	1	Quantitative Equilibria	Applying	8.1.j
10	1	10	1	Quantitative Equilibria	Reasoning	8.1.f
11	1	11	1	Electrochemistry	Knowing	9.1.d
12	1	12	1	Electrochemistry	Applying	9.1.d
13	1	13	1	Electrochemistry	Applying	9.1.g,o
14	1	14	1	Electrochemistry	Reasoning	9.1.p
	2	15.a.i	1	An introduction to the chemistry of transition elements	knowing	6.2.a
		15.a.ii	1	An introduction to the chemistry of transition elements	knowing	6.2.e
		15.a.iii	2	An introduction to the chemistry of transition elements	Applying	6.2.d
		15.b	1	An introduction to the chemistry of transition elements	knowing	6.1.d
		15.c.i	1	An introduction to the chemistry of transition elements	knowing	6.2.e
		15.c.ii	1	An introduction to the chemistry of transition elements	Applying	6.2.d
		16.a	1	An introduction to the chemistry of transition elements	Knowing	6.2.a
		16.b	2	An introduction to the chemistry of transition elements	Applying	6.2.d

	16.c	1	An introduction to the chemistry of transition elements	Applying	6.2.d
	16.d	1	An introduction to the chemistry of transition elements	Reasoning	6.2.e
	16.e	2	An introduction to the chemistry of transition elements	Reasoning	6.2.c
	17.a.i	1	Quantitative Kinetics	Knowing	7.1.d
	17.a.ii	1	Quantitative Kinetics	Knowing	7.1.d
	17.a.iii	1	Quantitative Kinetics	Knowing	7.1.d
	17.b.i	1	Quantitative Kinetics	Reasoning	7.1.i
	17.b.i	1	Quantitative Kinetics	Reasoning	7.1.i
	17.c	1	Quantitative Kinetics	Applying	7.1.e
	18.a	1	Quantitative Kinetics	Applying	7.1.i
	18.b	2	Quantitative Kinetics	Applying	7.1.k
	18.c	1	Quantitative Kinetics	Applying	7.1.f
	19.a	1	Quantitative Equilibria	Knowing	8.1.e
	19.b	1	Quantitative Equilibria	Knowing	8.1.d
	19.c	3	Quantitative Equilibria	Applying	8.1.f, i
	20.a	1	Quantitative Equilibria	Knowing	8.1.a
	20.b	1	Quantitative Equilibria	Knowing	8.1.j
	20.c	2	Quantitative Equilibria	Reasoning	8.1.k
	21.a	1	Quantitative Equilibria	Knowing	8.1.l
	21.b	4	Quantitative Equilibria	Applying	8.1.O
	21.c.i	1	Quantitative Equilibria	Applying	8.1.m
	21.c.ii	1	Quantitative Equilibria	Reasoning	8.1.m
	22.a.i	3	Electrochemistry	Knowing	9.1.i
	22.a.ii	1	Electrochemistry	Knowing	9.1.j
	22.a.iii	1	Electrochemistry	Knowing	9.1.j
	22.a.iv	1	Electrochemistry	Applying	9.1.h
	22.b	1	Electrochemistry	Applying	9.1.g
	22.c	1	Electrochemistry	Applying	9.1.g
	22.d	2	Electrochemistry	Applying/ Reasoning	9.1.m
	22.e	1	Electrochemistry	Applying	9.1.n
	22.f	1	Electrochemistry	Applying	9.1.o
	23.a.i	1	Electrochemistry	Applying	9.2.a
	23.a.ii	1	Electrochemistry	Applying	9.2.a
	23.b.i	1	Electrochemistry	Reasoning	9.2.a
	23.b.ii	1	Electrochemistry	Reasoning	9.2.a

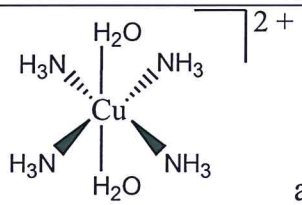
TOTAL MARKS: 70 **PAGES: 6**

Question One (14 Marks)

There are 14 multiple-choice items. Each correct answer is worth ONE mark.

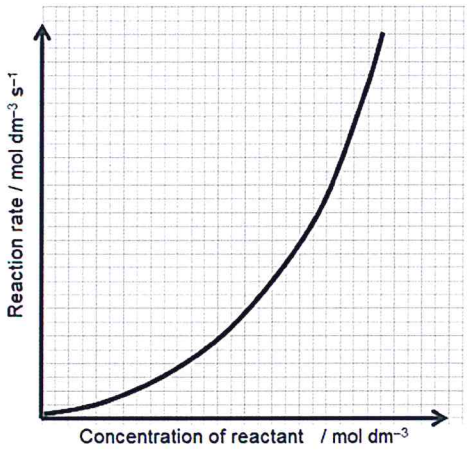
Item		Correct option
1		**b) $C_2O_4^{2-}$**
2		**a) [Ar] $3d^5$**
3		d) octahedral +3
4		d) second- order dependent on the initial concentration
5		c) mol dm^{-3} s^{-1}
6		d) If $[ClO_2]$ is doubled, the reaction rate will increase by a factor of 4.
7		d. 1.0×10^{-14}
8		b. methyl red
9		b. Weak acid- strong base
10		**a. D**
11		c) gain electrons
12		a) PbO
13		c) Cu 0.78
14		c) Zn^{2+} , Cu

Question Two (56 Marks)

Part	*Section*	*The answer*	*The mark*
15	a.i	Are d-block elements which form one or more stable ions with incomplete orbitals.	1 mark
	a.ii	$[Cu\ (NH_3)_4(H_2O)_2]^{2+}$	1 mark
	a.iii	 any octahedral geometry with the right number of H_2O and NH_3 is correct, and two marks are given.	2
	b	Because the 4s with a half-filled subshell is an energetically preferred configuration or to avoid the inter-electron repulsion	1
	c.i	$[CuCl_4]^{2-}$	1
	c.ii	Tetrahedral	1

Part	*Section*	*The answer*	*The mark*
16	a.	A molecule or ion with one or more lone pairs of electrons which form dative covalent bonds to a central transition element atom or ion	1
	b.	+2 , coordination number= 6	2
	c.	bidentate	1
	d	6 pairs	1
	e	CH_3CH_3, because ethane molecule has no lone pair for dative bond	2

Part	Section	The answer	The mark
17	a.i	An equation showing the relationship between the rate constant and the concentrations of the species that affect the rate of reaction.	1
	a.ii	The power to which the concentration of the reactant is raised in the rate equation.	1
	a.iii	The time taken for the amount (or concentration) of the limiting reactant in a reaction to decrease to half its initial value.	1
	b.i	First-order	1
	b.ii	Second-order	1
	c	$R = k [PCl_3] [Cl_2]^2$	1

Part	Section	The answer	The mark
18	a	Second-order.	1
	b	3.0×10^{-3} mol dm^{-3} s^{-1} = k (0.6 mol dm^{-3})^2 $k = \underline{8.3 \times 10^{-3}}$ $\underline{\text{dm}^3\ \text{mol}^{-1}\ \text{s}^{-1}}$ 1 mark 1 mark	2
	c		1 mark

Part	Section	The answer	The mark
19	a	$K_a = \frac{[H^+][CH3COO^-]}{[CH3COOH]}$	1
	b	temperature.	1
	c	$[H^+] = \sqrt{(K_a \times C)}$ $(0.005)^2 = K_a \times 0.15$ (1) $K_a = 1.67 \times 10^{-4}$ mol dm^{-3} (1) $pK_a = -\log K_a$ $pK_a = 3.78$ (1)	3

Part	Section	The answer	The mark
20	a	A reaction that does not go to completion in which reactants and products are present in fixed concentration ratios.	1
	b	9.0 ± 1	1
	c	NO Because its color-change range (pH range) is NOT covered by the steep portion of the titration curve. OR Methyl yellow would not be a suitable indicator to use because it only changes colour in acidic region (2.9-4.0) that do not correspond to the sharp pH change.	2
21	a	A solution whose pH is totally unaffected by the addition of small quantities of acid or alkali.	1

	b	The sodium hydroxide reacts with hydrofluoric acid (HF) $[OH^-] = 0.05$ mol dm^{-3} so $[NaF] = 0.06 + 0.05 = 0.11$ mol dm^{-3} (1) $[HF] = 0.08 - 0.05 = 0.030$ mol dm^{-3} (1) $K_a = \frac{[H^+][F^-]}{[HF]}$ $5.6 \times 10^{-4} = \frac{[H^+](0.11)}{(0.030)}$ **(1)** $[H^+] = 1.5 \times 10^{-4}$ mol dm^{-3} pH= - log $[H^+]$ = 3.82 **(1)** OR pH = pK_a + log $(\frac{[F^-]}{[HF]})$ = - log (5.6×10^{-4}) + log $(\frac{(0.11)}{(0.030)}) = 3.82$	4 marks
	c.i	-When a small amount of hydrochloric acid is added to this buffer solution, most of the extra H^+ (aq) ions react with the reservoir of F^-(aq), and this tends to minimise the decrease in pH. - The extra H^+ (aq) react with F^-(aq) ions and the equilibrium moves to the left to remove the added H^+ (aq), and this tends to minimise the decrease in pH. -The extra H^+ (aq) react with F^-(aq) ions to form the weak acid HF (aq), and this tends to minimise the decrease in pH. **Any answer from above mark is given.**	1 mark
	c.ii	F^-(aq) + H^+ (aq) → HF (aq) The physical states of this reaction are not necessary.	1 mark

Part	***Section***	***The answer***	***The mark***
22	a.i	Temperature of 25 °C (298 K), 1 mark Pressure of 1 atmosphere(101 kPa) 1 mark Concentration of the aqueous solution is 1.00 mol dm^{-3} 1 mark	3 marks
	a.ii	H_2(g)	1
	a.iii	Platinum	1
	a.iv	To measure the E^θ value for Mg^{2+}/ Mg half-cell.	1
	b	Mg(s) ⟶ Mg^{2+}(aq) +2e$^-$	1
	c	The electrons move in the external circuit from the Mg^{2+} / Mg half-cell to the H^+ / H_2 half-cell.	1

	d	The magnesium electrode decreases in mass. 1 mark Because the magnesium goes into the solution as magnesium ions. 1 mark	2
	e	$Mg(s) \mid Mg^{2+} \vdots 2H^{+}(aq) \mid H_2(g)$, Pt	1
	f	$E^{\theta}_{cell} = E^{\theta}(2H^{+}/H_2) - E^{\theta}(Mg^{2+}/Mg) = 0.00 - (-2.38) = \underline{2.38V}$	1

Part	***Section***	***The answer***	***The mark***
23	a	The anode: $2Cl^{-} \rightarrow Cl_2 + 2e^{-}$ The cathode: $K^{+} + e^{-} \rightarrow K$	1 1
	b	The anode: Chlorine or Cl_2 The cathode: Potassium or K	1 1

This is the end of the Marking Guide

MARKING GUIDE

GENERAL EDUCATION DIPLOMA

BILINGUAL PRIVATE SCHOOLS

SEMESTER TWO - FIRST SESSION

CHEMISTRY

2021 / 2022

Exam Specifications: General Education Diploma, Semester Two, First Session, Bilingual Private Schools, Chemistry, 2021/2022

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		No. of Items	Cognitive levels			Marks	No. of questions	Marks	Cognitive levels			
			Knowing (30%)	Applying (50%)	Reasoning (20%)				Knowing (30%)	Applying (50%)	Reasoning (20%)	
Chemical Energetics	35%	5	1	3	1	5	10	20	6	10	4	25
Quantitative Kinetics	15%	2	1	1	-	2		8	2	4	2	10
Quantitative Equilibrium	35%	5	2	2	1	5		20	6	10	4	25
Electrochemistry	15%	2	-	1	1	2		8	3	4	1	10
Total	100%	14	4	7	3	14		56	18	27	11	70

Distribution of cognitive domains and marks.

Serial No	Item	Mark	Unit	Page	cognitive domains	output
1	1	1	Chemical Energetics	297	Knowing	6.1.d
2	2	1	Chemical Energetics	296	Applying	6.1.e
3	3	1	Chemical Energetics	290	Applying	6.1.f
4	4	1	Chemical Energetics	291	Reasoning	6.2.c
5	5	1	Chemical Energetics	293	Applying	6.1.f
6	6	1	Quantitative Kinetics	353,354,349,350	Knowing	7.1e , 7.1h
7	7	1	Quantitative Kinetics	357	Applying	7.1c.i
8	8	1	Quantitative Equilibria	369	Knowing	8.1.c
9	9	1	Quantitative Equilibria	370	Knowing	8.1.f
10	10	1	Quantitative Equilibria	367	Applying	8.1.e
11	11	1	Quantitative Equilibria	367	Applying	8.1.g
12	12	1	Quantitative Equilibria	373	Reasoning	8.1.j
13	13	1	Electrochemistry	444	Reasoning	9.1.f
14	14	1	Electrochemistry	445	Applying	9.1.n

Item	Mark	Unit	Page	cognitive domains	Output
15a	1	Chemical Energetics	299	Knowing	6.1.d
15b	2	Chemical Energetics	291	Applying	6.1.b 6.1.c
15c	4	Chemical Energetics	293	Reasoning	6.1.f
16a	1	Chemical Energetics	297	Knowing	6.1.a
16b	3	Chemical Energetics	298	Knowing	6.1.a 6.1.b
16c	1	Chemical Energetics	295	Applying	6.2.b
16d	1	Chemical Energetics	297	Applying	6.2.b
17a	1	Chemical Energetics	294	Knowing	6.2.a
17b	2	Chemical Energetics	296	Applying	6.2.b
17c	4	Chemical Energetics	300	Applying	6.2.c
18.a.i	1	Quantitative Kinetics	353-355	Knowing	7.1.d.ii
18.a.ii	1	Quantitative Kinetics	353	Knowing	7.1d.iv
18.iii	1	Quantitative Kinetics	350-357	Applying	7.1.l
18.b	1	Quantitative Kinetics	349-351	Applying	7.1.e
18.c	2	Quantitative Kinetics	353-355	Applying	7.1.h, 7.1.i
18.d.i	1	Quantitative Kinetics	356-357	Reasoning	7.1.k
18.d.ii	1	Quantitative Kinetics	356-357	Reasoning	7.1.l
19.a	1	Quantitative Equilibria	367	Applying	8.1.e
19.b	1	Quantitative Equilibria	367	Knowing	8.1.d
19.c	3	Quantitative Equilibria	368	Applying	8.1.h
20.a	2	Quantitative Equilibria	373	Knowing	8.1.j
20.b	2	Quantitative Equilibria	373	Knowing	8.1.j
20.c	2	Quantitative Equilibria	374	Reasoning	8.1.k
21.a	1	Quantitative Equilibria	371	Knowing	8.1.l
21.b	4	Quantitative Equilibria	371	Applying	8.1.n
21.c	2	Quantitative Equilibria	371	Applying	8.1.n
21.d	2	Quantitative Equilibria	372	Reasoning	8.1.m
22.a.i	1	Electrochemistry	441-445	knowing	9.1.c
22.a.ii	1	Electrochemistry	441-445	knowing	9.1.c
22.a.iii	1	Electrochemistry	444	knowing	9.1.k

23.a.i	1	Electrochemistry	445	Applying	9.1.m
23.a.ii	1	Electrochemistry	445	Applying	9.1.n
23.a.iii	2	Electrochemistry	445	knowing and applying	9.1.o
23.b	1	Electrochemistry	445	Applying	9.1.n

TOTAL PAGES: 6 MARKS: 70

Question One (14 Marks)

There are 14 multiple-choice items. Each correct answer is worth ONE mark.

Item No.	Correct option
1	The energy released is more than the energy required
2	$CO + 1/2O_2 \rightleftharpoons CO_2$
3	-92.3
4	2Y-2X
5	$2Na+½O_2 \rightarrow Na_2O$
6	C | $Rate=k[R]^2$ | A parabola starting at the origin
7	c. Rate $=K[NO_2]^2[CO]^0$
8	a. K_w is equal to $[H_3O^+]^2$.
9	c. K_a increases pK_a decreases.
10	b. mol dm^{-3}
11	c. $\frac{K_a\ [H_2SO_3]}{[HSO_3^-]}$
12	**d. 2.0 9.0**
13	c) Electrons will flow from Zn to Ag
14	d) + 1.56 V

Question Two (56 marks)

2

Part	*Section*	*The answer*	*The mark*
15	a.	The enthalpy change needed or produced when 1 mole of solution is produced or (if the definitions of lattice dissociation or lattice formation or the enthalpy of solution are written are accepted)	1
	b.	Endothermic(1 mark) The energy value increased or the energy of products is higher than the energy of reactants(1 mark)	2
	c.	n.ΔH=-m.c.ΔT $\Delta T = -\frac{n.\Delta H}{m.c}$ (1 mark for one of the equation) $n = \frac{m}{Mr} = \frac{5.85g}{58.5g/mol}$=0.10 mol (1 mark) $.\Delta T = -\frac{0.10mol \times 40000J.mol-1}{500g \times 4.18\frac{J}{g.^oC}}$= -1.91 °C (calculate from the graph 40000 J.mol is 1 mark) $\Delta T = T_f - T_i$ $T_f = 26 + (-1.91) = \mathbf{24.09} \approx 24$ (1 mark)	4
16	a.	The heat is taken in from the surrounding. Or the enthalpy of the product is more than the enthalpy of the reactant. Or the enthalpy increases that ΔH **is positive.** **Or the temperature of the system increased.** **Or the temperature of the surrounding decreases.**	1
	b.i	System: A Surrounding: B	2
	b.ii	A to B	1
	c.	$\Delta H = 232 + (-111) = +121\,J$	1
	d.	Positive	1
17	a.	- if a chemical change takes place by several different routes, the overall enthalpy change is the same, regardless of the route by which the chemical change occurs.	1

		- the change of enthalpy in a chemical reaction is the same regardless of whether the reaction takes place in one step or several steps, provided the initial and final states of the reactants and products are the same. Any	
	b.	i- $\Delta H = -483.6\ kJ$ $\Delta H_f = \frac{\Delta H}{n} = \frac{-483.6kJ}{2mol}$ (1 mark) $= -241.8\ ^{kJ}/_{mol}$ (1 mark)	1 1
	c.	$B_2O_3(s) + 3H_2O(g) \rightarrow B_2H_6(g) + 3O_2(g)$ $\Delta H = 2036\ kJ$ (1 mark) $2B(s) + {}^3/_2\ O_2(g) \rightarrow B_2O_3(s)$ $\Delta H = -1247\ kJ$ (1 mark) $(\times\ {}^3/_2)2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$ $\Delta H = -483.6\ kJ$ $3H_2(g) + {}^3/_2\ O_2(g) \rightarrow 3H_2O(g)$ $\Delta H = -725.4\ kJ$ (1 mark) --- $2B(s)+3H_2(g) \rightarrow B_2H_6(g)$ $\Delta H = 63.6\ kJ$ (1 mark)	1 2 1

Part	***Section***	***The answer***	***The mark***
18	**a.i**	How the concentration of a reactant affects the rate of a reaction or any correct definitions 1 mark is given	1 mark
	a.ii	It is the time taken for the concentration of a reactant to decrease to half its initial value.	1 mark
	a.iii	To measure the gradient of the concentration of [A] against time at various times in order to find the rates. These rates can then be plotted against concentration of [A]. Or by Studying the graph between concentration of [A] against the rates. Or by the initial rates method by keeping all reactants except one in excess. Or by clock method by giving a value for the initial rate that is lower than the true value, because it assumes that the concentration time graph is a straight line until the clock stop or to be done experimentally or colorimeter. -Any answer from above mark is given.	1 mark
	B	Rate$=\frac{-\Delta[A]}{\Delta t}$ or Rate $=K[A]^2$	1 mark
	c	Second order. (1mark) Because the curve is not exponential or the curve has different half-lives ($t_{½}$) or the successive half-lives are not the same or the successive half-lives become longer or because the time taken for the concentration of the reactant (A) to decrease from [A] to ½[A] from (0.20) to (0.05) is not the same as the time taken for the	2 marks

		concentration of the reactant (A) to decrease from ½[A] to ¼[A] from (0.05) to (0.025). Or because it requires double time to decrease the second half compared to the first half. (1mark) -Any answer from above mark is given.	
	d.i	Rate=$\frac{-\Delta[A]}{\Delta t}$ or Rate=$\frac{-\Delta[0.025-0.20]}{\Delta(17-0)}$(1mark) = 10.29 x$10^{-3}$ mol dm^{-3} s^{-1}	1 mark
	d.ii	Rate= K$[A]^2$ or 10.29 x10^{-3} mol dm^{-3} s^{-1}=k[0.025 mol dm^{-3}]^2 k= 16.46 mol^{-1} dm^3 s^{-1}	1 mark

Continue Question Two

Part	***Section***	***The answer***	***The mark***
19	**a**	$K_a = \frac{[H^+][CN^-]}{[HCN]}$	1 mark
	b	Change temperature.	1 mark
	c	$\mathbf{4.9 \times 10^{-10}} = \frac{[x][x]}{[0.25]}$ OR $[H^+] = \sqrt{(K_a \times C)}$ (1mark) $[H^+] = \mathbf{11.07 \times 10^{-6}}$ mol dm^{-3} (1mark) pH= - log $[H^+]$ = 4.96 (1mark)	3 marks

Part	***Section***	***The answer***	***The mark***
20	**a**	-Titration curve A: Strong alkali(base) – Strong acid -Titration curve B: Strong alkali(base) – Weak acid	2 marks
	b	-Titration curve A: 7.0 ± 1 -Titration curve B: 9.0 ± 1	2 marks
	c	Phenolphthalein (1 mark) Because its colour-change range (pH range) is covered by the steep portion of both titration curves A and B. (1 mark)	2 marks
21	**a**	A solution whose pH is totally (almost) unaffected by the addition of small quantities of acid or alkali. Or A solution that can resist large sudden change in pH, when a small amount of acid or base is added.	1 mark
	b	$K_a = \frac{[H^+][HCO_2^-]}{[HCO_2H]}$ After mixing the volume is 200 cm^3 , so $[HCO_2H] = 0.15$ mol dm^{-3} and $[HCO_2^-] = 0.15$ mol dm^{-3}	4 marks

		$1.6 \times 10^{-4} = \frac{[H^+](0.15)}{(0.15)}$ $[H^+] = 1.6 \times 10^{-4}$ mol dm^{-3} pH= - log $[H^+]$ = 3.80 OR pH = pK_a + log $(\frac{[HCO_2^-]}{[HCO_2H]})$ = - log (1.6×10^{-4}) + log $(\frac{(0.15)}{(0.15)})$ = 3.80	
	c	The hydrochloric acid reacts with HCO_2^- [H+] = 0.01/0.2 dm^{-3} = 0.05 mol dm^{-3} (1 mark) so $[HCO_2^-] = 0.15 - 0.05 = 0.10$ mol dm^{-3} $[HCO_2H] = 0.15 + 0.05 = 0.20$ mol dm^{-3} $K_a = \frac{[H^+][HCO_2^-]}{[HCO_2H]}$ (1 mark) $1.6 \times 10^{-4} = \frac{[H^+](0.10)}{(0.20)}$ $[H^+] = 3.2 \times 10^{-4}$ mol dm^{-3} pH= - log $[H^+]$ = 3.50 OR pH = pK_a + log $(\frac{[HCO_2^-]}{[HCO_2H]})$ (or 1 mark if this equation is written) = - log (1.6×10^{-4}) + log $(\frac{(0.10)}{(0.20)})$ = 3.50	2 marks
	d.i	When a small amount of sodium hydroxide is added to this buffer solution, <u>most of the extra OH^- (aq) ions react with the reservoir of HCO_2H(aq),</u> and this tends to minimise the increase in pH. Or OH^- ions will be neutralized by H^+ forming water, so equilibrium shifts to right hand side.	1 mark
	d.ii	$HCO_2H(aq) + OH^-(aq) \rightarrow HCO_2^-(aq) + H_2O(l)$ $H^+ + OH^- \rightarrow H_2O$ The physical states of this reaction are not necessary.	1 mark
22	**a.i**	Fe^{2+}	1 mark
	a.ii	F_2O	1 mark
	a.iii	Fe^{2+} and Cl^-	1 mark
23	**a.i**	($Cr^{2+}_{(aq)}$ I $Cr^{3+}_{(aq)}$ II $Cu^{2+}_{(aq)}$ I $Cu_{(s)}$)	1 mark
	a.ii	E^0_{cell} = + 0.34 – (-0.41) = + 0.75 V	1 mark
	a.iii	feasible, because E^0_{cell} is psotive.	2 marks
	b.	E^0_{cell} = - 2.37 – (+ 0.34) = - 2.71 V	1 mark

MARKING GUIDE

GENERAL EDUCATION DIPLOMA
BILINGUAL PRIVATE SCHOOLS
SEMESTER TWO - SECOND SESSION

CHEMISTRY
2021 / 2022

General Education Diploma, Semester Two, Second Session
Bilingual Private Schools, Chemistry, 2021/2022

Exam Specifications:

Topics of the units	Weighting %	Multiple choice (20%)					Extended response (80%)					Total
		No. of Items	Cognitive levels			Marks	No. of questions	Marks	Cognitive levels			
			Knowing (30%)	Applying (50%)	Reasoning (20%)				Knowing (30%)	Applying (50%)	Reasoning (20%)	
Chemical Energetic	35%	5	1	3	1	5	10	20	6	10	4	25
Quantitative Kinetics	15%	2	1	1	-	2		8	2	4	2	10
Quantitative Equilibrium	35%	5	2	2	1	5		20	6	10	4	25
Electrochemistry	15%	2	-	1	1	2		8	3	4	1	10
Total	100%	14	4	7	3	14		56	17	28	11	70

Distribution of cognitive domains and marks.

Serial No	Item	Mark	Unit	Page	cognitive domains	output
1	1	1	Chemical Energetic	297	Knowing	6.2.a
2	2	1	Chemical Energetic	296	Applying	6.1.e
3	3	1	Chemical Energetic	290	Applying	6.1.f
4	4	1	Chemical Energetic	291	Reasoning	6.1.f
5	5	1	Chemical Energetic	293	Applying	6.2.b
6	6	1	Quantitative Kinetics	349-353	Knowing	7.1.d.i
7	7	1	Quantitative Kinetics	350,351	Applying	7.1e
8	8	1	Quantitative Equilibria	368	Knowing	8.1.c
9	9	1	Quantitative Equilibria	368	Knowing	8.1.g
10	10	1	Quantitative Equilibria	369	Applying	8.1.g
11	11	1	Quantitative Equilibria	371	Applying	8.1.m
12	12	1	Quantitative Equilibria	374	Reasoning	8.1.j
13	13	1	Electrochemistry	443	Reasoning	9.1-j
14	14	1	Electrochemistry	445	Applying	9.1.m

Item	Mark	Unit	Page	cognitive domains	output
15a	1	Chemical Energetic	299	Knowing	6.1.d
15b	1	Chemical Energetic	291	Applying	6.1.b
15c	2	Chemical Energetic	293	Reasoning	6.1.f
15d	2	Chemical Energetic	297	Reasoning	6.1.f
16a	1	Chemical Energetic	298	Knowing	6.1.d
16b	3	Chemical Energetic	295	Knowing	6.1.d
16c.i	2	Chemical Energetic	297	Applying	6.1.f
16c.ii	1	Chemical Energetic	294	Applying	6.1.d
17a	1	Chemical Energetic	296	Knowing	6.1.d
17b	4	Chemical Energetic	300	Applying	6.2.c
17c	1	Chemical Energetic	299	Applying	6.1.b
17d	1	Chemical Energetic	291	Applying	6.1.f
18.a	1	Quantitative Kinetics	349	Knowing	7.1.d.i
18.b	1	Quantitative Kinetics	351	Knowing	7.1.d.i

18.c	4	Quantitative Kinetics	356	Applying	7.1.i
18.d	1	Quantitative Kinetics	356	Reasoning	7.1.j
18.e	1	Quantitative Kinetics	356	Reasoning	7.1.k
19.a	1	Quantitative Equilibrium	8.1.i	Applying	367
19.b	1	Quantitative Equilibrium	8.1.i	Applying	367
19.c	1	Quantitative Equilibrium	8.1.d	Knowing	367
19.d	2	Quantitative Equilibrium	8.1.e	Applying	367
19.e	3	Quantitative Equilibrium	8.1.h	Applying	368
20.a	2	Quantitative Equilibrium	8.1.j	Knowing	374
20.b	2	Quantitative Equilibrium	8.1.j	Knowing	374
20.c	2	Quantitative Equilibrium	8.1.k	Reasoning	374
21.a	1	Quantitative Equilibrium	8.1.l	Knowing	371
21.b	3	Quantitative Equilibrium	8.1.n	Applying	371
21.c	2	Quantitative Equilibrium	8.1.m	Reasoning	371
22.a	1	Electrochemistry	445	Applying	9.1-c
22.b	3	Electrochemistry	444	Knowing	9.1-h
22.c.i	1	Electrochemistry	443	Applying	9.1-a
22.c.ii	1	Electrochemistry	441	Reasoning	**9.1-f**
23.a.i	1	Electrochemistry	445	Applying	9.1-n
23.a.ii	1	Electrochemistry	446	Applying	9.1-L

General Education Diploma, Semester Two, Second Session
Bilingual Private Schools, Chemistry, 2021/2022

TOTAL PAGES: 5 **MARKS: 70**

Question One (14 Marks)

There are 14 multiple-choice items. Each correct answer is worth ONE mark.

Item No.	Correct option
1	c) It is not necessary to consider the number of moles in summation of reaction
2	d) $2HCl+Ca(OH)_2 \rightarrow CaCl_2+2H_2O$
3	a) -393.5
4	d) -37.5
5	b) $4HCl(g)+ O_2(g) \rightarrow 2Cl_2(g)+ 2H_2O(g)$
6	a) It always has positive value.
7	c) 1 and 4 only
8	d. $mol^2\ dm^{-6}$
9	d. 1.0×10^{-14}
10	b. 2.0×10^{-14} mol dm^{-3}
11	c. CH_3CO_2H react with OH^-.
12	c. Phenolphthalein (pH range 8.2 – 10.0).
13	a) It is unreactive
14	b) $Pt\|1/2H_2\|H^+ \| Fe^{3+}, Fe^{2+}\|Pt$

General Education Diploma, Semester Two, Second Session
Bilingual Private Schools, Chemistry, 2021/2022

Question Two (56 Marks)

15	a.	Positive or negative	1
	b.	Exothermic	1
	c.	n.ΔH=-m.c.ΔT $n = -\frac{m.c.\Delta T}{\Delta H}$ $n = -\frac{1000x4.18x5}{-30000}$ =0.697 ≈ 0.7 moles	1 1
	d.	$n = \frac{m}{Mr}$ $Mr = \frac{29.4}{0.7}$ =42 g.mol^{-1} 23 + MrX= 42 MrX = 19 g.mol^{-1}	1 1
16	a.	The enthalpy change is produced when 1 mole of solid crystal is formed from its scattered gaseous ions	1
	b.	energy: Produced / Absorbed; Sign of **energy enthalpy**: negative / positive; Occur when: Forming bonds / breaking	3
	c.i	$\Delta H = 353 - 437$ $= -84\ kJ$	1 1
	c.ii	Reactants	1
17	a.	The enthalpy change is produced when 1 mole of matter reacts (burns) with oxygen	1
	b.	$2C_3H_6(g) + 2H_2(g) \rightarrow 2C_3H_8(g)$ $\Delta H = -248\ kJ$ $2C_3H_8(g) + 10O_2(g) \rightarrow 6CO_2(g) + 8H_2O(l)$ $\Delta H = -4440\ kJ$ $2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$ $\Delta H = 572\ kJ$ --- $2C_3H_6(g) + 9O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$ $\Delta H = -4116\ kJ$	1 1 1 1
	c.	Exothermic	1
	d.	- 2220 kJ	1

General Education Diploma, Semester Two, Second Session
Bilingual Private Schools, Chemistry, 2021/2022

Part	Section	The answer	The mark
18	a.	How the concentration of a product P increases with time, or how the concentration of a reactant R decreases with time. Or it tells us how quickly the reaction happens.	1mark
	b.	-Follow the change in concentration/ volume of a reactant/ product. Or follow the change in color / colorimetry / less light transmission / measure absorbance -One mark is given for the above answers.	1 mark
	c.	Order with respect to A: First order (1mark) Explanation: From experiments 1 and 2 as [A] is increased (doubled) in the ratio 1:2, so the initial rate again is increased(doubled) in the ratio 1:2 (when [B] does not change)Therefore, the reaction is first order with respect to A or by calculation $R_2/R_1=k[A]^x[B]^y/\ k[A]^x[B]^y$ so $4x10^{-3}/2x10^{-3}= k(0.2)^x(0.1)^y/\ k(0.1)^x(0.1)^y$ so $2^1=2^y$ so y=1 (1mark) Order with respect to B: Second order. (1mark) Explanation: From experiments 2 and 3 as [B] is increased in the ratio 1:4, so the initial rate again is increased in the ratio 1:4 (when [A] does not change)Therefore, the reaction is second order with respect to B or by calculation $R_3/R_2=k[A]^x[B]^y/\ k[A]^x[B]^y$ so $16x10^{-3}/4x10^{-3}= k(0.2)^x(0.2)^y/\ k(0.2)^x(0.1)^y$ so $4=2^y$ so $2^2=2^y$ so y=2 (1mark)	4 marks
	d.	rate = $k[A]^1[B]^2$ or R= $k[A][B]^2$	1 mark
	e.	$R_2=K[A]^1[B]^2$ so $4.00 \times 10^{-3}= k(0.200)(0.100)^2$ (½mark) $k = 2\ mol^{-1}dm^3s^{-1}$ (½mark) -If a student gets the final value without writing the rate law or substitution 1 mark is given. -Units are not necessary.	1 mark

Part	Section	The answer	The mark
19	19.a	H_2SO_3	1 mark
	19.b	HCN	1 mark
	19.c	Change in temperature.	1 mark
	19.d.i	$K_a = \frac{[H^+][HSO_3^-]}{[H_2SO_3]}$	1 mark
	19.d.ii	mol dm^{-3}	1 mark
	19.e	$K_a = \frac{[H^+][CH_3CO_2^-]}{[CH_3CO_2H]}$ $1.7 \times 10^{-5} = \frac{[x][x]}{[0.06]}$ OR $[H^+] = \sqrt{(K_a \times C)}$ (1mark) $[H^+] = 1.02 \times 10^{-6}$ mol dm^{-3} (1mark) pH= - log $[H^+]$ = 5.99 (1mark)	3 marks

Part	Section	The answer	The mark
20	20.a	-Titration curve A: Strong acid – Strong alkali (base) -Titration curve B: Weak acid– Strong alkali (base)	2 marks
	20.b	-Titration curve A: 7.0±1 -Titration curve B: 9.0±1	2 marks
	20.C	Methyl orange (1mark) Because its color-change range (pH range) is covered by the steep portion of the titration curve A only. (1mark)	2 marks

Part	Section	The answer	The mark
	21.a	A solution whose pH is totally unaffected by the addition of small quantities of acid or alkali.	1 mark
	21.b	$K_a = \frac{[H^+][HCO_2^-]}{[HCO_2H]}$ $1.6 \times 10^{-4} = \frac{[H^+](0.30)}{(0.25)}$ (1mark) $[H^+] = 1.3 \times 10^{-4}$ mol dm^{-3} (1mark) pH = - log $[H^+]$ = 3.88 (1mark) OR $pH = pK_a + \log(\frac{[HCO_2^-]}{[HCO_2H]})$ (1mark) $= -\log(1.6 \times 10^{-4}) + \log(\frac{(0.30)}{(0.25)})$ (1mark) = 3.88 (1mark)	3 marks
	21.c.i	When a small amount of hydrochloric acid is added to this buffer solution, most of the extra H^+ (aq) ions react with the reservoir of HCO_2^-(aq), and this tends to minimise the decrease in pH.	1 mark
	21.c.ii	$HCO_2^-(aq) + H^+(aq) \rightarrow HCO_2H(aq)$	1 mark

Part	Section	The answer	The mark
	22.a	e.m.f = +0.52 – (-0.88) = 1.40 V	1 mark
	22.b	298 K 1.00 bar or 1.00 atm Solutions of 1.00 mol dm^{-3}	3 marks
	22.c.i	NiO(OH)	1 mark
	22.c.ii	+2	1 mark
	23.a.i	**e.m.f. = E(rhs) - E(lhs)** **= 1.52 - 0.77 = + 0.75 V**	1
	23.a.ii	**$Fe^{2+} \rightarrow Fe^{3+} + e^-$**	1

This is the end of the Marking Guide

MARKING GUIDE

GENERAL EDUCATION DIPLOMA

BILINGUAL PRIVATE SCHOOLS

FIRST SESSION

CHEMISTRY

2020 / 2021

General Education Diploma, End of year exam, First Session
Bilingual Private Schools, Chemistry, 2020/2021

Exam Specifications:

Topics of the units	No. of outcomes	Weighting %	Multiple choice (20%)					Extended response (80%)					Total mark
			No. of Items	Marks	Cognitive levels			No. of questions	Marks	Cognitive levels			
					Knowing (30%)	Applying (50%)	Reasoning (20%)			Knowing (30%)	Applying (50%)	Reasoning (20%)	
An introduction to the chemistry of transition elements	9	14%	2	2	1	1	-	8	6	2	3	1	8
Arenes and phenols	6	10%	1	1	-	1	-		5	1	3	1	6
Carboxylic acids	5	8%	1	1	-	1	-		4	-	2	2	5
Nitrogen compounds	12	19 %	2	2	-	1	1		9	3	5	1	11
Chemical energetics	5	8 %	1	1	1	-	-		4	1	2	1	5
Quantitative kinetics	1	2 %	-	-	-	-	-		1	1	-	-	1
Quantitative equilibria	11	18 %	2	2	1	1	-		9	3	4	2	11
Electrochemistry	13	21 %	3	3	1	1	1		10	3	5	2	13
Total	62	100%	14	14	4	6	2	8	48	14	24	10	60

General Education Diploma, End of year exam, First Session
Bilingual Private Schools, Chemistry, 2020/2021

Distribution of cognitive domains and marks.

Item	Mark	Unit	Page	cognitive domains	output
1	1	Transition elements	413	Knowing	1.2(a-b-c-d)
2	1	Transition elements	402	Applying	1.1.g
3	1	Arenes and phenols	415-419	Applying	2.1 a.i
4	1	Carboxylic acids	309-443	Applying	3.2.b,f
5	1	Nitrogen Compounds	450	Applying	4.1.a
6	1	Nitrogen Compounds	459	Reasoning	4.2.c
7	1	Chemical Energetic	100	knowing	6.1e.i , 6.1f.i
8	1	Quantitative Equilibria	373	knowing	8.1.j
9	1	Quantitative Equilibria	370	Applying	8.1.h
10	1	Electrochemistry	381-387	knowing	9.1a
11	1	Electrochemistry	384-387	Applying	9.1n
12	1	Electrochemistry	385-387	Reasoning	9.1j

Item	Mark	Unit	Page	cognitive domains	output
13.a	1	Transition elements	407	Applying	1.2(b)
13.b	2	Transition elements	408	Knowing +Reasoning	1.2 (g)
13.c.i	1	Transition elements	406	Applying	1.2(f)
13.c.ii	1	Transition elements	404	Knowing	1.2(d)
13.c.iii	1	Transition elements	404	Applying	1.2(d)
14.a	1	Arenes and phenols	430	Applying	2.1 b
14.b	1	Arenes and phenols	421	Applying	2.1 (j) i
14.c	1	Arenes and phenols	426	Knowing	2.1 (f) i
14.d	2	Arenes and phenols	434	Applying+Reasoning	2.1 (j) ii
15.a	1	Carboxylic acids	445	Applying	3.2 (e)
15.b	1	Carboxylic acids	443	Reasoning	3.2 (f)
15.c	1	Carboxylic acids	444	Applying	3.2(e)
15.d	1	Carboxylic acids	444	Reasoning	3.2 (a)+(e)
16.a.i	1	Nitrogen Compounds	458+459	Applying	4.1.d
16.a.ii	1	Nitrogen Compounds	451	Applying	4.1.b
16.a.iii	1	Nitrogen Compounds	459	Applying	4.2.c
16.b.i	1	Nitrogen Compounds	464	knowing	4.2.h
16.b.ii	1	Nitrogen Compounds	462	knowing	4.2.f
16.b.iii	2	Nitrogen Compounds	464	Applying	4.2.h
16.c.i	1	Nitrogen Compounds	460	knowing	4.2.d
16.c.ii	1	Nitrogen Compounds	460	Reasoning	4.2.d
17.a	1	Chemical Energetic	108	knowing	6.2.a
17.b	2	Chemical Energetic	108-116	Applying	6.2b
17.c	1	Chemical Energetic	108-116	Reasoning	6.2b +6.2c
18	1	Chemical Kinetics	353	knowing	7.1.a

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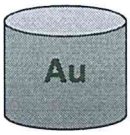
Item	Mark	Unit	Page	cognitive domains	Output
19.a.i	1	Quantitative Equilibrium	368	knowing	8.1.c
19.a.ii	1	Quantitative Equilibrium	369	knowing	8.1.d
19.b.i	1	Quantitative Equilibrium	367	Applying	8.1.e
19.b.ii, iii	2	Quantitative Equilibrium	373,367	Applying	8.1.j,f
19.c	1	Quantitative Equilibrium	374	Applying	8.1.k
19.d.i	1	Quantitative Equilibrium	371	knowing	8.1.l
19.d.ii	2	Quantitative Equilibrium	371	Reasoning	8.1.m
20.a	2	Electrochemistry	382	Knowing	9.1.g
20.b	1	Electrochemistry	383	Knowing	9.1.c.iv
20.c.i	1	Electrochemistry	381-387	Applying	9.1a , 9.1.c.ii
20.c.ii	1	Electrochemistry	384	Applying	9.1l
20.c.iii	1	Electrochemistry	381-387	Applying	9.1k
20.d.i	2	Electrochemistry	381-387	Applying	9.1k
20.d.ii	2	Electrochemistry	385-387	Reasoning	9.1m + 9.1n

General Education Diploma, End of year exam, First Session
Bilingual Private Schools, Chemistry, 2020/2021

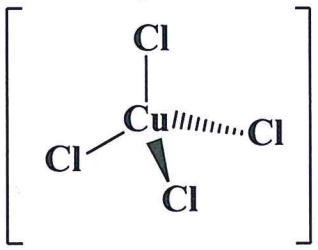
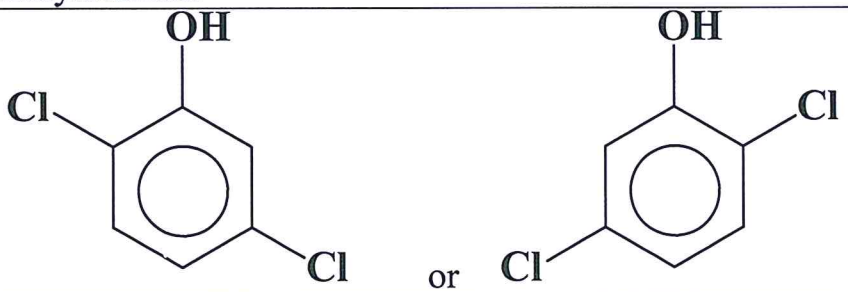
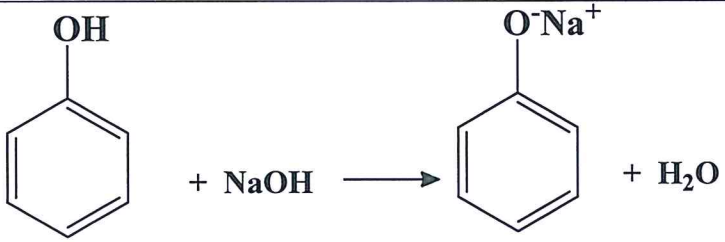
TOTAL MARKS: 60 **PAGES: 5**

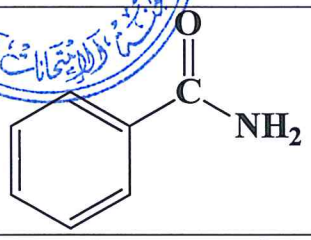
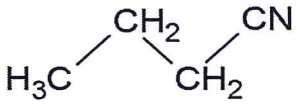
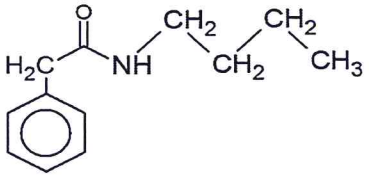
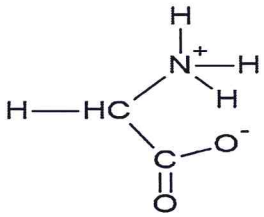
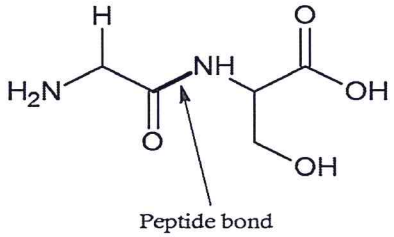
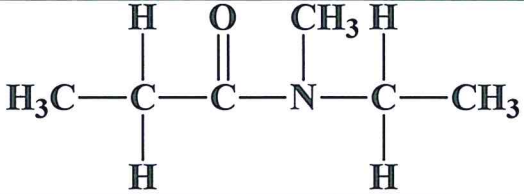
Question One (12 Marks)

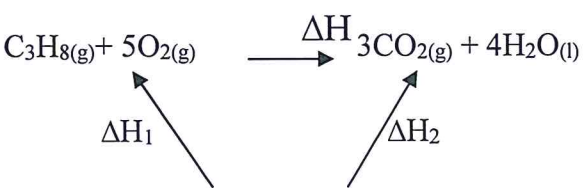
There are 12 multiple-choice items. Each correct answer worth ONE mark.

Item No.	Correct option
1	c. The ions of all the 3d-block elements form complex ions by donating electrons.
2	b. +2 +7
3	c. It Shows the typical reactions of alkenes
4	d. $CH_3CH_2CH_2COCl$ Carboxylic acid
5	a. Amine
6	d. CH_3CH_2COCl with $CH_3CH_2NH_2$
7	a. This reaction is endothermic.
8	c. Weak acid with strong alkali Strong acid with strong alkali
9	d. 13.3
10	b. The reducing agent undergoes oxidization .
11	b. 
12	c. A > B > C

QUESTION TWO: Extened respone (48 marks)

Part	Section	The answer	Mark
13	a.	+2	1
	b.	Bidentate (1 mark) Because Each ligand joins by two bonds to the metal ion **OR** Each ligand attached by two coordinate bonds to the metal ion **OR** each ligand contains two lone pairs of electrons **OR** Ligands have two donor atoms which allow them to bind to central metal atom (1 mark)	2
	c.i	 To get the mark both the 3D shape and the charge should be correct.	1
	c.ii	Olive green or green or yellow	1
	c.iii	6 or six	1
14	a.	Ethylbenzene	1
	b.		1
	c.	acyl chloride and aluminum chloride ($AlCl_3$)	1
	d.	 To get the mark both reactant and products should be correct.	2

Part	Section	The answer	Marks
15	a.		1
	b.	The electronegativity of the oxygen and the easily polarized C=O double bond ,have dramatic effect on the reactivity of acylchloride compared with that of chloroalkanes	1
	c.	Nucleophilic substitution reaction	1
	d.	amide	1
16.a	i		1 mark
	ii.	Butylamine Or (1-aminobutane)	1 mark
	iii.		1 mark
16.b	i.	Condensation reaction.	1 mark
	ii.		1 mark
	iii.	 1 mark for the structure, 1 mark for the peptide bond.	2 marks
16.c	i.	Heating with NaOH(aq). -To get the mark both answers should be mentioned.	1 mark
	ii.		1 mark

Part	Section	The answer	The mark
17	a.	The enthalpy changes in turning any reactants into a set of products is the same no matter what route we take. Or the enthalpy change for a reaction is independent of the path taken. Or the value of the enthalpy change for a reaction is the same whether we carry out the reaction in one step or in many steps.	1 mark
	b.	The enthalpy cycle will be:  ($\frac{1}{2}$ *mark)* $\Delta H^e_c[C_3H_{8(g)}] + \Delta H = 3x\Delta H^e_c [CO_{2(g)}]+ 4x\Delta H^e_c [H_2O_{(l)}]$ ($\frac{1}{2}$ *mark)* $-286+ \Delta H =(3 \times -393)+(4x-286)$($\frac{1}{2}$ *mark)* $\Delta H =(3 \times -393)+(4x-286)+ 286= - 2037$ kJ mol^{-1} ($\frac{1}{2}$ *mark)* **Or** $\Delta H_2 = (\Delta H^e_f[C_3H_{8(g)}]) = (- 286)$ kJ mol^{-1}($\frac{1}{2}$ *mark)* $\Delta H_3 =(3x\Delta H^e_f[CO_{2(g)}] + 4x\Delta H^e_f[H_2O_{(l)}])= (3 \times -393)+(4x-286)= -2323$ kJ mol^{-1} ($\frac{1}{2}$ *mark)* From the enthalpy cycle : $\Delta H = \Delta H_2 - \Delta H_1$($\frac{1}{2}$ *mark)* $\Delta H = -2323 - (-286) = - 2037$ kJ mol^{-1} ($\frac{1}{2}$ *mark)* **OR** $\Delta H^e = (3x\Delta H^e_f[CO_{2(g)}] + 4 \times \Delta H^e_f[H_2O_{(l)}]) - (\Delta H^e_f[C_2H_5OH_{(l)}])$ ($\frac{1}{2}$ *mark)* $= (3 \times -393) + (4 \times -286) - (- 286)$ ($\frac{1}{2}$ *mark)* $= -2037$ kJ mol^{-1} (*1 mark)* (*If a student did not write the equation but applied directly and correctly mark is given)*	2 marks
	c.	Because the ΔH^e has a negative sign or ΔH^e has a negative number. or the products have less enthalpy than the reactants. or the difference in the enthalpy (ΔH^e) of the chemicals is given out as heat.	1 mark
18		It is the time taken for the concentration of a reactant to decrease to half its initial value.	1 mark

Part	Section	The answer	The mark
19.a	i	$K_w = [H_3O^+][OH^-]$	1 mark
	ii.	The temperature	1 mark
19.b	i.	$Ka = [H_3O^+(aq)]\,[CH_3CO_2^-(aq)]/\,[CH_3CO_2H\,(aq)]$	1 mark
	ii.	pH = 9.0 (allow value between 8 to 11)	1 mark
	iii.	pH for the ethanoic acid =3 thus: $Ka = (1.0 \times 10^{-3})(1.0 \times 10^{-3})/\,0.06 = 1.67 \times 10^{-5}$ mol dm^{-3}	1 mark
19.c		Phenolphthalein	1 mark
19.d	i.	A solution whose pH is totally unaffected by the addition of small quantities of acid or alkali.	1 mark
	ii.	In this buffer solution the equilibrium: $H_2CO_3(aq) \rightleftharpoons H^+(aq) + HCO_3^-(aq)$ (1 mark) When a small amount of strong acid is added, most of the extra $H^+(aq)$ ions react with the reservoir of $HCO_3^-(aq)$, and so the equilibrium moves to the left to remove the added H^+. This tends to minimise the decrease in pH. (1 mark)	2 marks
20	a.	T= 298K or 25C° (1mark) , concentration = 1.00 mol dm^{-3} (1mark)	2
	b.	To complete the circuit or to allow ions to flow while minimising the mixing of the electrolytes by diffusion. Or to complete the electrical circuit allowing the movement of ions between the two half-cells so that ionic balance is maintained	1
	c.i	Al or aluminum	1
	c.ii	$Al_{(s)} \mid Al^{3+}_{(aq)} \parallel X^{2+}_{(aq)} \mid X_{(s)}$	1
	c.iii	$2Al_{(s)} + 3X^{2+}_{(aq)} \rightarrow 2Al^{3+}_{(aq)} + 3X_{(s)}$ -To get the mark all components of the equation should be correct -Balancing is not necessary.	1
	d.i	The half-cell oxidation reaction: $X_{(s)} \rightarrow X^{2+}_{(aq)} + 2e^-$ (1mark) The half-cell reduction reaction: $Ag^+_{(aq)} + e^- \rightarrow Ag_{(s)}$ (1mark)	2
	d.ii	* from cell (1) $Al_{(s)} \mid Al^{3+}_{(aq)} \parallel X^{2+}_{(aq)} \mid X_{(s)}$ $E^\Theta_{cell} = E^\Theta_{right\text{-}hand\ half\text{-}cell} - E^\Theta_{left\text{-}hand\ half\text{-}cell}$ $0.9 = E^\Theta_{(X)} - (-1.66)$ $\therefore E^\Theta_{(X)} = +0.76$ V(1mark) * from cell (2) $E^\Theta_{cell} = E^\Theta_{right\text{-}hand\ half\text{-}cell} - E^\Theta_{left\text{-}hand\ half\text{-}cell}$ $= E^\Theta_{(Ag)} - E^\Theta_{(X)}$ $= (+0.80) - (+0.76) = +0.04$ V (1mark)	2

This is the end of the Marking Guide.

MARKING GUIDE

GENERAL EDUCATION DIPLOMA
BILINGUAL PRIVATE SCHOOLS
SECOND SESSION

CHEMISTRY
2020 / 2021

General Education Diploma, Second Session
Bilingual Private Schools, Chemistry, 2020/2021

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An introduction to the chemistry of transition elements	9	14%	2	2	1	1	-	8	6	2	3	1	8
Arenes and phenols	6	10%	1	1	-	1	-		5	1	3	1	6
Carboxylic acids	5	8%	1	1	-	1	-		4	-	2	2	5
Nitrogen compounds	12	19 %	2	2	-	1	1		9	3	5	1	11
Chemical energetics	5	8 %	1	1	1	-	-		4	1	2	1	5
Quantitative kinetics	1	2 %	-	-	-	-	-		1	1	-	-	1
Quantitative equilibria	11	18 %	2	2	1	1	-		9	3	4	2	11
Electrochemistry	13	21 %	3	3	1	1	1		10	3	5	2	13
Total	62	100%	14	14	4	6	2	8	48	14	24	10	60

Distribution of cognitive domains and marks.

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4	1	Carboxylic acids	444	Applying	3.2 (e)
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6	1	Nitrogen Compounds	459	Reasoning	4.2.c
7	1	Chemical Energetic	101	knowing	6.1e.ii ,6.1 f.ii
8	1	Quantitative Equilibria	373	knowing	8.1.j
9	1	Quantitative Equilibria	374	Applying	8.1.j
10	1	Electrochemistry	381-387	knowing	9.1a
11	1	Electrochemistry	384-387	Applying	9.1n + 9.1j
12	1	Electrochemistry	385-387	Reasoning	9.1m

Item	Mark	Unit	Page	cognitive domains	output
13.a	1	Transition elements	403	Knowing	1.2(a)
13.b	1	Transition elements	406 407	Knowing	1.2(f) (annex)
13.c	2	Transition elements	407	Applying+reasoning	1.2 (e-f)
14.	2	Transition elements	402 404	Applying	1.2(b) 1.2(d)
15.a	1	Arenes and phenols	421	Applying	2.1 (b)
15.b	1	Arenes and phenols	434	Applying	2.1(a) 2.1 (j)
16.a	1	Arenes and phenols	417	Knowing	2.1(d)
16.b	1	Arenes and phenols	417	Reasoning	2.1 (b)
16.c	1	Arenes and phenols	418	Applying	2.1f
17.a	1	Carboxylic acids	443	Reasoning	3.2 (d)
17.b	1	Carboxylic acids	445	Applying	3.2 (e)
17.c	1	Carboxylic acids	309	Reasoning	3.2(b)
17.d	1	Carboxylic acids	445	Applying	3.2 (a)
18.a.i	1	Nitrogen Compounds	459	Applying	4.2.c
18.a.ii	1	Nitrogen Compounds	451	knowing	4.1.b
18.a.iii	2	Nitrogen Compounds	458	Applying	4.1.d
18.a.iv	2	Nitrogen Compounds	460	Applying	4.2.d
18.b.i	1	Nitrogen Compounds	461	knowing	4.2.e
18.b.ii.a	1	Nitrogen Compounds	464	knowing	4.2.h
18.b.ii.b	1	Nitrogen Compounds	464	Reasoning	4.2.h
19.a	1	Chemical Energetic	102-111	knowing	6.2.a
19.b	2	Chemical Energetic	108-116	Applying	6.2b
19.c	1	Chemical Energetic	108-116	Reasoning	6.2b
20	1	Chemical Kinetics	349	knowing	7.1.a

General Education Diploma, Semester One, Second Session
Bilingual Private Schools, Chemistry, 2020/2021

Item	Mark	Unit	Page	cognitive domains	output
21.a.i	1	Quantitative Equilibrium	371	knowing	8.1.l
21.a.ii	1	Quantitative Equilibrium	371	knowing	8.1.l,m
21.b.i	1	Quantitative Equilibrium	367	knowing	8.1.e
21.b.ii	2	Quantitative Equilibrium	368	Applying	8.1.h
21.c.i	1	Quantitative Equilibrium	373	Applying	8.1.j
21.c.ii	1	Quantitative Equilibrium	374	Applying	8.1.j
21.c.iii	2	Quantitative Equilibrium	374	Reasoning	8.1.k
22.a	1	Electrochemistry	383	Knowing	9.1.c.iv
22.b	1	Electrochemistry	386	Knowing	9.1.d
22.c	1	Electrochemistry	386-387	Applying	9.1n
22.d	1	Electrochemistry	384	Applying	9.1l
22.e	1	Electrochemistry	381-387	Applying	9.1k
22.f	3	Electrochemistry	381-387	Applying	9.1c
22.g	2	Electrochemistry	385-387	Reasoning	9.1m + 9.1n

General Education Diploma, Semester One, Second Session
Bilingual Private Schools, Chemistry, 2020/2021

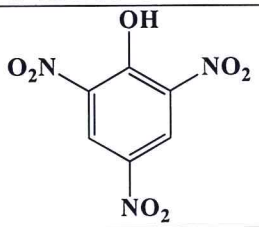
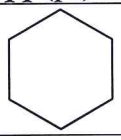
TOTAL MARKS: 60 **PAGES: 6**

Question One (12 Marks)
There are 12 multiple-choice items. Each correct answer worth ONE mark.

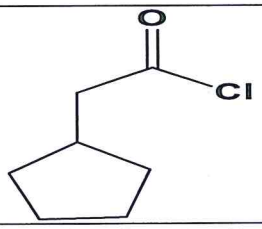
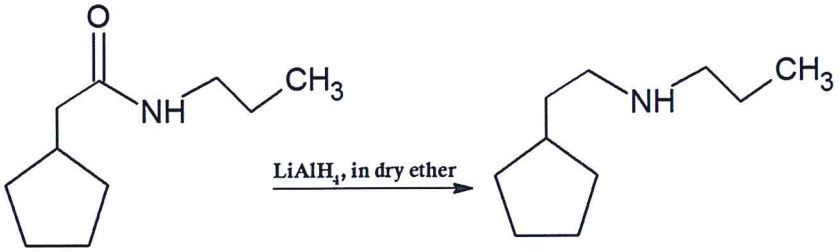
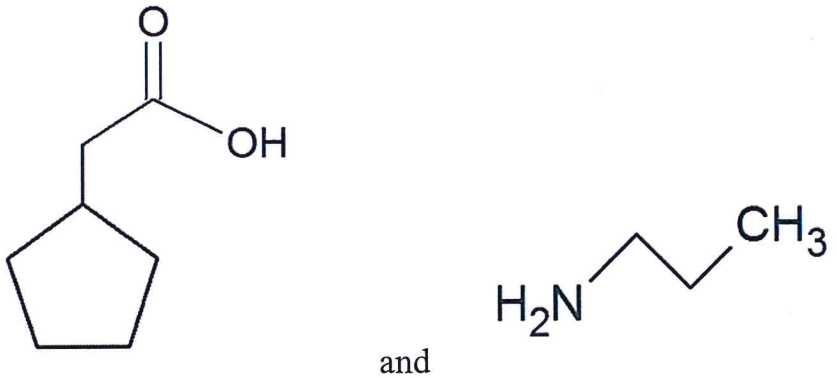
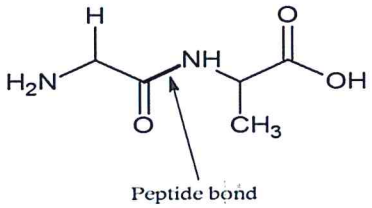
Item No.	Correct option
1	d. $[Co(NH_2CH_2CH_2NH_2)]^{2+}$
2	a. Octahedral
3	b) Aluminum chloride with heat
4	b-esters
5	a) Amine
6	b) $CH_3CH_2CH_2COCl$ and NH_3
7	b) The heat is given out to the surrounding.
8	d) Weak acid with weak alkali
9	c) Z
10	b) The reducing agent undergoes oxidization.
11	d) $Al_{(s)}$
12	c) Ag , Al

Question Two (48 Marks)

Part	Section	The answer	Mark
13	a	Complex ion: a central transition metal ion surrounded by ligand	1
	b	1-orange Or Red brown	1
	c	$[Fe(H_2O)_6]^{3+} \xrightarrow{3NaOH} [Fe(H_2O)_3(OH)_3]^{3+}$ (1 mark) (1 mark)	2
14		Number of dative bonds: 6; The oxidation state of the central metal: +3	2

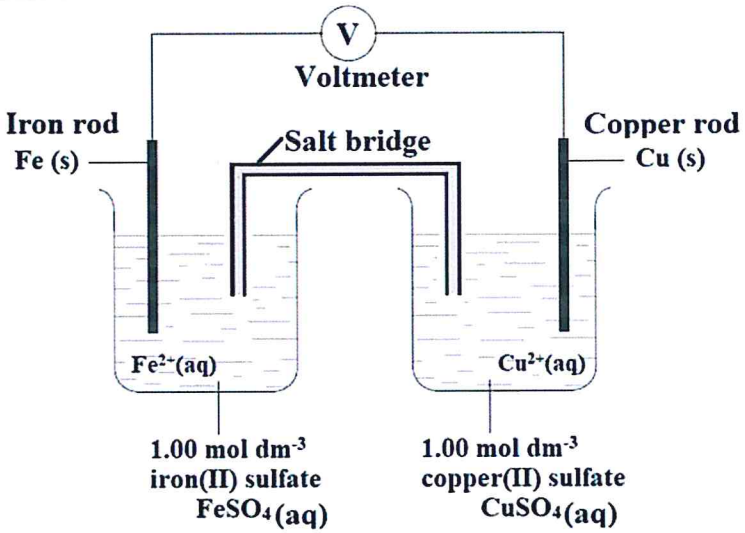
Part	section	The answer	Marks
15	a.	3-nitrobromobenzene	1
	b.		1
16	a.	120°	1
	b.	Because the benzene consists of six carbon atoms arranged in a regular hexagon or p orbitals are all parallel to each other and perpendicular to the plane of the ring Or p orbitals overlap equally with both neighbors forming a delocalized six -centre molecular ∏ (pi) orbital.	1
	c.		1

Part	Section	The answer	Marks
17	a	CH_3CH_2COOH	1
	b	Nucleophilic substitution	1
	c.	$3\ CH_3CH_2COOH + PCl_3 \rightarrow 3CH_3CH_2COCl + H_3PO_3$ $3\ CH_3CH_2COOH + PCl_5 \rightarrow 3CH_3CH_2COCl + POCl_3 + HCl$ Or $CH_3CH_2COOH + SOCl_2 \rightarrow CH_3CH_2COCl + SO_2 + HCl$ Balancing is not necessary. To get the mark all components should be written.	1
	d.	3-bromobutanoylchloride	1

Part	Section	The answer	The mark
18.a	i		1 mark
	ii.	Propylamine Or (1-aminopropane)	1 mark
	iii.	 1 mark for the reagent and 1 mark for the product. If the student write the reagent H_2 mark is given.	2 marks
	iv.	 and 1 mark for each product.	2 marks
18.b	i.	Amino acids.	1 mark
	ii.a	Peptide or dipeptide	1 mark
	ii.b		1 mark

Part	Section	The answer	The mark
19.	a	0 or zero	1 mark
	b.	The enthalpy cycle will be: $\Delta H^{\ominus}$ $N_{2(g)} + 2O_{2(g)} \longrightarrow 2NO_{(g)} + O_{2(g)}$ $\Delta H^{e}_1 = 68$ KJ mol^{-1} ; $\Delta H^{e}_2 = -112$ KJ mol^{-1} $2NO_{2(g)}$ (*½mark*) $\Delta H^{e}_1 = 68$ KJ mol^{-1} $\Delta H^{e}_2 = -112$ KJ mol^{-1} $2\Delta H^{e}_f[NO_{2(g)}] + \Delta H^{\ominus} = 2\Delta H^{e}_f [NO_{(g)}] + 2\Delta H^{e}_f [NO_{2(g)}]$ (*½mark*) $(2x34) + \Delta H^{\ominus} = (2x90) + (2x34)$ (*½mark*) $\Delta H^{\ominus} = 180$kJ mol^{-1} (*½mark*) Or From the enthalpy cycle: $\Delta H^{\ominus} + \Delta H^{e}_2 = \Delta H^{e}_1$ or $\Delta H^{\ominus} = \Delta H^{e}_1 - \Delta H^{e}_2$ (*½mark*) $\Delta H^{\ominus} = 68 - (-112)$ kJ mol^{-1} (*½mark*) $\Delta H^{\ominus} = 180$kJ mol^{-1} (*1 mark*) OR $\Delta H^{e} = (2x\Delta H^{e}_f[NO_{(g)}] + \Delta H^{e}_f [O_{2(g)}] - [2\Delta H^{e}_f[N_{2(g)}] + 2x\Delta H^{e}_f[O_{2(g)}]$ (*½mark*) $= (2 \times 90 + 1x0) - [(2 x0 + 2x0)]$ (*½mark*) $= 180$ kJ mol^{-1} (*1 mark*) (*If a student did not write the equation but applied directly and correctly mark is given*)	2 marks
	d	endothermic(*½mark*) Because the ΔH^{e} has a positive sign or ΔH^{e} has a positive number or the products have more enthalpy than the reactants or the reactants have less enthalpy than the products or the difference in the enthalpy (ΔH^{e}) of the chemicals is taken in as heat. Or because energy is added to the system (*½mark*)	1 mark
20		How the concentration of a product P increases with time, or how the concentration of a reactant R decreases with time. Or it tells us how quickly the reaction happens.	1mark

Part	Section	The answer	The mark
21.a	i.	A solution whose pH is totally unaffected by the addition of small quantities of acid or alkali.	1 mark
	ii.	A mixture of a weak acid and its conjugate base (salt), **Or** a mixture of a weak base and its conjugate acid(salt).	1 mark
21.b	i.	$Ka = [H^+] [A^-] /[HA]$	1 mark
	ii.	$Ka = 6.3 \times 10^{-5} = [H^+]^2/0.05$ $[H^+]=\sqrt{(Ka \times c)} = \sqrt{(6.3 \times 10^{-5}) \times 0.05)}$ $[H^+]= 0.00177$ mol dm^{-3} (1 mark) $pH = - Log10[H^+]$ pH= 2.75 (1 mark) If the student got the final result directly the mark is given.	2 marks
21.c	i.	9.0 or any number between 8 to 11.	1 mark
	ii.	5.0 or any number between 5 to 5.5	1 mark
	iii.	Phenolphthalein (1 mark) Because phenolphthalein has pH range 8.2 to 10.0 whose colour change is covered by the equivalence point of the titration curve (1 mark)	2 marks

Part	Section	The answer	The mark
22	a.	Salt bridge	1mark
	b.	The electrons flow from the negative electrode to the positive electrode.	1mark
	c.	By using the standard electromotive force (E^{Θ}_{cell}) values. or using the standard electrode potentials values	1mark
	d.	$Mg(s) \mid Mg^{2+}(aq) \parallel Cu^{2+}(aq) \mid Cu(s)$	1mark
	e.	Zinc or Zn(s)	1mark
	f.	 -**Complete circuit** involving labelled voltmeter; labelled salt bridge; (1 mark) -**Solutions** two separate solutions are iron(II) sulfate $FeSO_4$ with iron or Fe rod and copper(II) sulfate $CuSO_4$ with copper or Cu rod (1 mark) - **Concentration** of solution(s) is 1 mol dm^{-3} or 1 M (1 mark)	3marks
	g.	$E^{\Theta}_{cell} = E^{\Theta}(Mn^{2+}_{(aq)} / Mn_{(s)}) - E^{\Theta}(Zn^{2+}_{(aq)} / Zn_{(s)})$ $= (-1.81) - (-0.76) = -1.05$ V (1mark) So the reaction is not feasible. (1mark)	2mark

(6)

This is the end of the Marking Guide