سلطنة عمان
وزارة التربية والتعليم

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

امتحان دبلوم التعليم العام
لكلية الحرس السلطاني العماني التقنية (ثنائية اللغة)
الفصل الدراسي الثاني - الدور الأول للعام الدراسي ١٤٤٧/١٤٤٦ هـ - ٢٠٢٤ / ٢٠٢٥ م

تنبيه:
- المادة: الكيمياء.
- الأسئلة في (١٦) صفحة.
- زمن الإجابة: ثلاث ساعات.
- الإجابة في الورقة نفسها.

تعليمات مهمة:

- يجب الحضور إلى قاعة الامتحان قبل عشر دقائق على الأقل من بدء زمن الامتحان.
- يجب إحضار أصل ما يثبت الهوية وإبرازها للعاملين بالامتحانات.
- يجب الالتزام بالزي (الدشداشة البيضاء والمصر أو الكمة للذكور) والزي المدرسي للطالبات ، ويستثنى من ذلك الدارسون من غير العمانيين بشرط الالتزام بالذوق العام، ويمنع على جميع المتقدمات ارتداء النقاب داخل المركز وقاعات الامتحان.
- يحظر على الممتحنين اصطحاب الهواتف النقالة وأجهزة النداء الآلي وآلات التصوير والحواسيب الشخصية والساعات الرقمية الذكية والآلات الحاسبة ذات الصفة التخزينية والمجلات والصحف والكتب الدراسية والدفاتر والمذكرات والحقائب اليدوية والآلات الحادة أو الأسلحة أياً كان نوعها وأي شيء له علاقة بالامتحان.
- يجب على الممتحن الامتثال لإجراءات التفتيش داخل المركز طوال أيام الامتحان.
- يجب على الممتحن التأكد من استلام دفتر امتحانه، مغلفاً بغلاف بلاستيكي شفاف وغير ممزق ، وهو مسؤول عنه حتى يسلمه لمراقبي اللجنة بعد الانتهاء من الإجابة.
- يجب الالتزام بضوابط إدارة امتحانات دبلوم التعليم العام وما في مستواه وأية مخالفة لهذه الضوابط تعرضك للتدابير والإجراءات والعقوبات المنصوص عليها بالقرار الوزاري رقم ٥٨٨ / ٢٠١٥.
- يقوم المتقدم بالإجابة عن أسئلة الامتحان المقالية بقلم الحبر (الأزرق أو الأسود).
- يقوم المتقدم بالإجابة عن أسئلة الاختيار من متعدد بتظليل الشكل (◯) وفق النموذج الآتي:

س - عاصمة سلطنة عمان هي:

◯ القاهرة ◯ الدوحة

● مسقط ◯ أبوظبي

ملاحظة يتم تظليل الشكل (●) باستخدام القلم الرصاص وعند الخطأ، امسح بعناية لإجراء التغيير.

صحيح ● **غير صحيح** ⊖ ◉ ◒ ⊗ ✓

مُسَوَّدَة، لا يتم تصحيحها

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Question 1: Multiple Choice Items (14 marks)

There are 14 multiple-choice items worth one mark each.
Shade in the bubble (⬭) next to the **correct** answer for each of the following items.

1) Which of the following is used as a catalyst in the esterfication of carboxylic acid with alcohol?

⬭ Strong acid
⬭ Strong base
⬭ Weak acid
⬭ Weak base

2) Which of the following is **not** a product in a substitution reaction of pentanol with PCl_5?

⬭ HCl
⬭ $SOCl_2$
⬭ $POCl_3$
⬭ $C_5H_{11}Cl$

3) Which of the following reactions is **correct** for the carboxylic acid HCOOH?

	Reactants	Products
⬭	HCOOH + NaOH	HCOONa + H_2
⬭	HCOOH + Ag	HCOOAg + H_2O
⬭	HCOOH + NaOH	HCOONa + H_2O
⬭	HCOOH + Ag	HCOOAg + CO_2 + H_2O

4) Which option indicates the **correct** classification for the given alcohol?

	Name	Classification
⬭	2-methylpropan-1-ol	Tertiary
⬭	2-methylbutan-2-ol	Tertiary
⬭	Butan-1-ol	Secondary
⬭	Propane-1,3-diol	Secondary

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Question 1 continued

5) Which reagent can be used to oxidize secondary alcohols to form ketones?

- ○ $SOCl_2$
- ○ $LiAlH_4$
- ○ $NaBH_4$
- ○ $K_2Cr_2O_7$

6) Which of the following compounds gives a yellow precipitate of tri-iodomethane when reacts with alkaline aqueous iodine?

A	CH_3CHO
B	CH_3COCH_3
C	CH_3CH_2CHO
D	$CH_3CH_2CH_2CHO$

- ○ A and B
- ○ A and C
- ○ B and C
- ○ **B** and D

7) What is the standard cell potential ($E^{\ominus}_{cell}$) in volt (V) for the ionic equation given below?

Half- cell equation	$E^{\ominus}$ (V)
$Cr^{3+}(aq) + 3e^- \rightleftharpoons Cr(s)$	−0.74
$Co^{2+}(aq) + 2e^- \rightleftharpoons Co(s)$	−0.28

- ○ +1.02
- ○ −1.02
- ○ +0.46
- ○ −0.46

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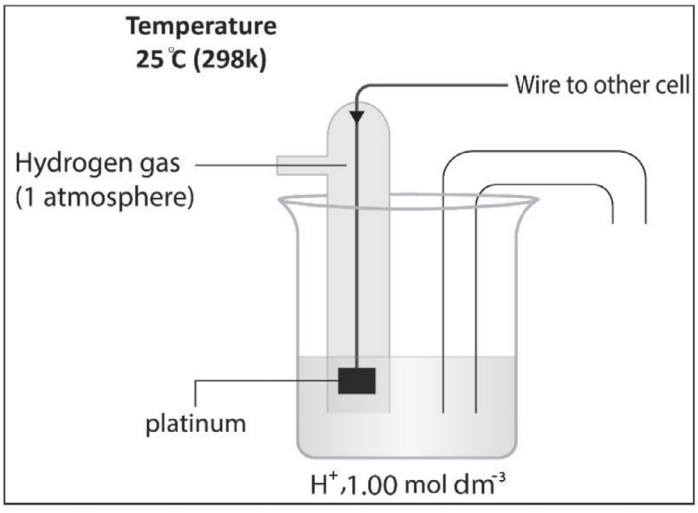
Question 1 continued

8) Using the data in the table below, which ion is the most easily reduced?

Half- cell equation	$E^{\ominus}$(V)
$Cu^{+}(aq) + e^{-} \rightleftharpoons Cu(s)$	+0.52
$Sn^{4+}(aq) + 2e^{-} \rightleftharpoons Sn^{2+}(aq)$	+0.15
$Ni^{2+}(aq) + 2e^{-} \rightleftharpoons Ni(s)$	−0.25
$Fe^{2+}(aq) + 2e^{-} \rightleftharpoons Fe(s)$	−0.44

- ⬭ Cu^{+}
- ⬭ Sn^{4+}
- ⬭ Ni^{2+}
- ⬭ Fe^{2+}

9) Which statement is **not correct** about the diagram below?

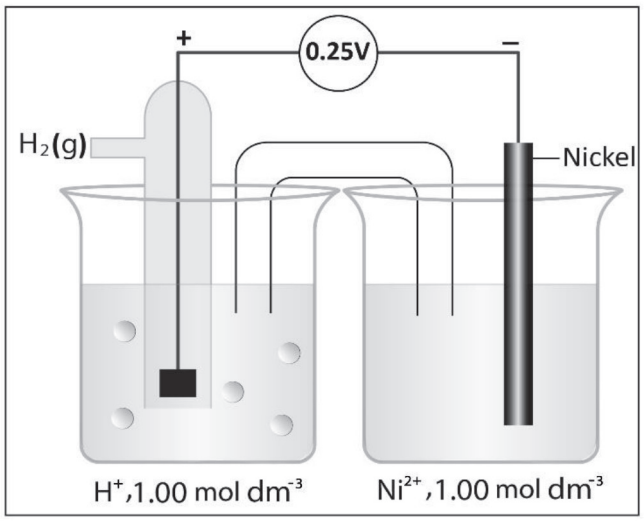


- ⬭ It represents the anode in all electrolytic cells.
- ⬭ It represents the standard hydrogen electrode.
- ⬭ The standard electrode potential of this electrode is 0.00 V.
- ⬭ It is used as a reference to measure the standard electrode potential.

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Question 1 continued

10) Which statement is correct for the voltaic cell below?



- ○ H_2 is a stronger reducing agent than Ni.
- ○ H^+ ions gain electrons more easily than Ni^{2+} ions.
- ○ The oxidation process occurs at the hydrogen half-cell.
- ○ Electrons (e^-) flow from the Hydrogen half-cell to the Nickel half-cell.

11) What happens at the (+) electrode in the following galvanic cell?

$$Mg(s) + Fe^{2+}(aq) \longrightarrow Mg^{2+}(aq) + Fe(s)$$

- ○ Reduction of Fe
- ○ Oxidation of Mg^{2+}
- ○ Reduction of Fe^{2+}
- ○ Oxidation of Mg

12) What is the half-equation for the reaction at the anode during the electrolysis of a diluted aqueous solution of (NaCl)?

- ○ $2Cl^- \longrightarrow Cl_2 + 2e^-$
- ○ $2H^+ + 2e^- \longrightarrow H_2$
- ○ $4OH^- \longrightarrow O_2 + 2H_2O + 4e^-$
- ○ $Na^+ + e^- \longrightarrow Na$

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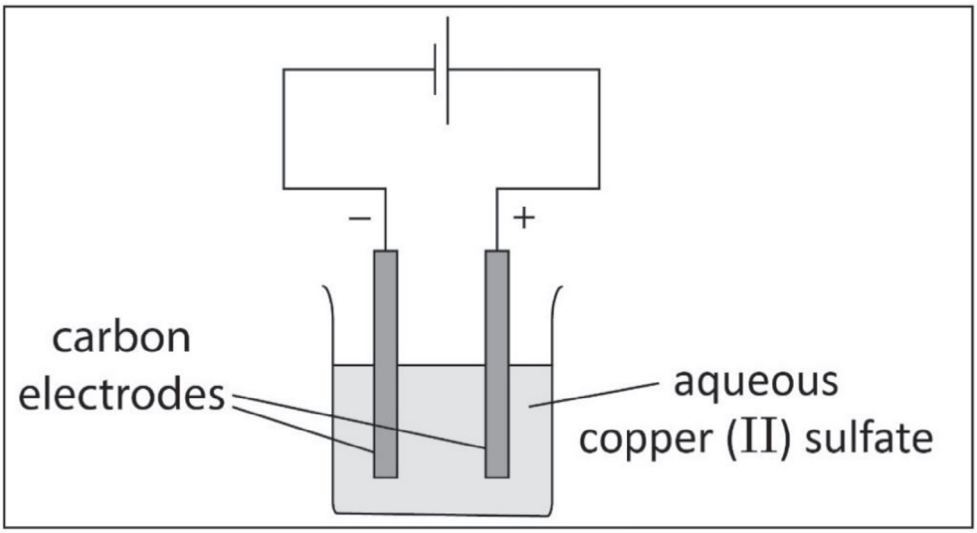
Question 1 continued

13) The mass of the substance (m) deposited or liberated at any electrode is directly proportional to the quantity of electricity or charge (Q) passed.

Which term is associated with the above statement?

- ○ Faraday's Law
- ○ Avogadro's Law
- ○ Faraday's constant
- ○ Avogadro's constant

14) Which substances are liberated during the electrolysis of aqueous electrolyte for the cell diagram below?



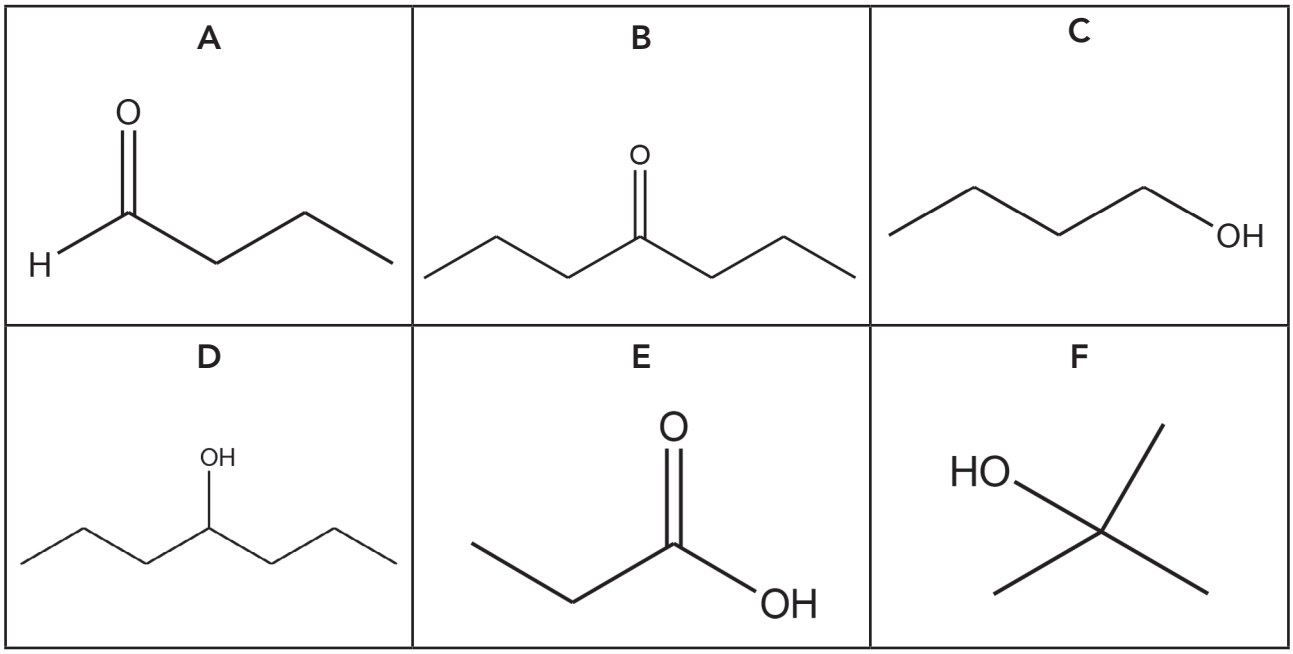
	(–)	(+)
○	Cu	H_2
○	Cu	O_2
○	H_2	Cu
○	O_2	Cu

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Question 2: Extended responses (56 marks)

Write your answer for each of the following questions in the space provided.
Be sure to show all your work, including the correct units where applicable.

15) Study the following organic compounds.



a. Using the compounds above:

(i) Complete the following equation:

$$\boxed{\qquad\qquad} + 2[H] \xrightarrow{LiAlH_4} \text{Secondary alcohol}$$ (1 mark)

(ii) State the reagent that can replace $LiAlH_4$ in this reaction?

_____ (1 mark)

b. Which symbol represents:

(i) The secondary alcohol: _____ (1 mark)

(ii) The alcohol that is produced by the reduction of a carboxylic acid:

_____ (1 mark)

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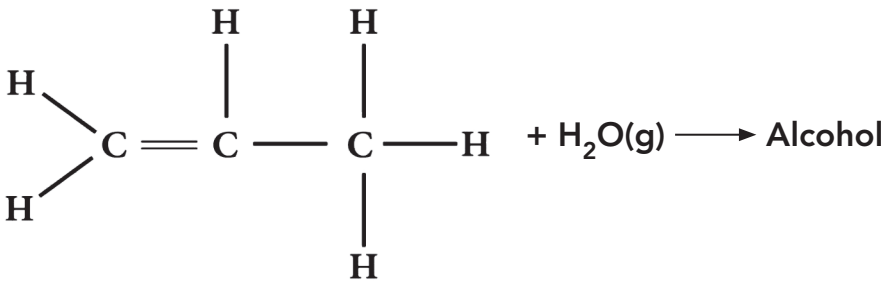
Question 2 continued

c. Complete the table using the mentioned compounds.

Statement (description)	Symbol
A compound that is reduced to form a primary alcohol.	
A compound that is classified as a tertiary alcohol.	
A carbonyl compound that can be produced by hydrolysing esters.	

(3 marks)

16) Study the following hydration reaction of propene.



a. For this reaction:

(i) Name the catalyst that is used.

_____ (1 mark)

(ii) State two conditions.

_____

_____ (2 marks)

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Question 2 continued

(iii) Draw the displayed formula of the produced alcohol.

(1 mark)

(iv) Classify the previous alcohol.

_____ (1 mark)

b. For the following reaction, **name compound (A)** that will be formed when propene is treated with cold, diluted acidified $KMnO_4$.

$$CH_2 = CHCH_3 + H_2O + [O] \longrightarrow \textbf{compound (A)}$$

_____ (1 mark)

17) Study the following oxidation reaction equation.

$$\textbf{Compound (Y)} \xrightarrow{(X)} CH_3CH_2CH_2CH_2CHO \xrightarrow{(X)} \textbf{Compound (Z)}$$

a. (i) Name the oxidizing agent (**X**).

_____ (1 mark)

(ii) Write the structural formula of:

Compound (Y): _____ (1 mark)

Compound (Z): _____ (1 mark)

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Question 2 continued

b. The equation below shows a chemical reaction.

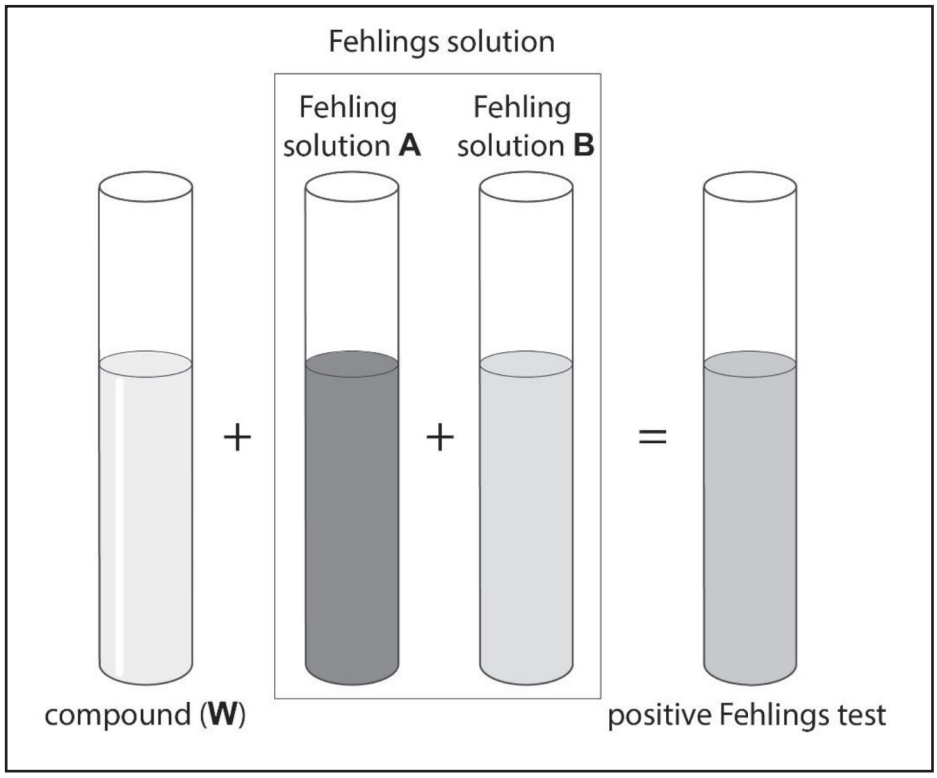
$$H_2O + \text{Salt} \xleftarrow{\text{Reaction (1)}} \text{Carboxylic acid} \xrightarrow{\text{Reaction (2)}} \text{Salt} + H_2$$

What is the reagent for:

Reaction (1): _____ (1 mark)

Reaction (2): _____ (1 mark)

18) Study the diagram below to answer the following questions.



a. What is the use of Fehling's reagent?

_____

_____ (1 mark)

b. What are the observations you expect to see in a positive Fehling's test?

_____

_____ (1 mark)

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Question 2 continued

c. What is the general formula of compound (**W**)?

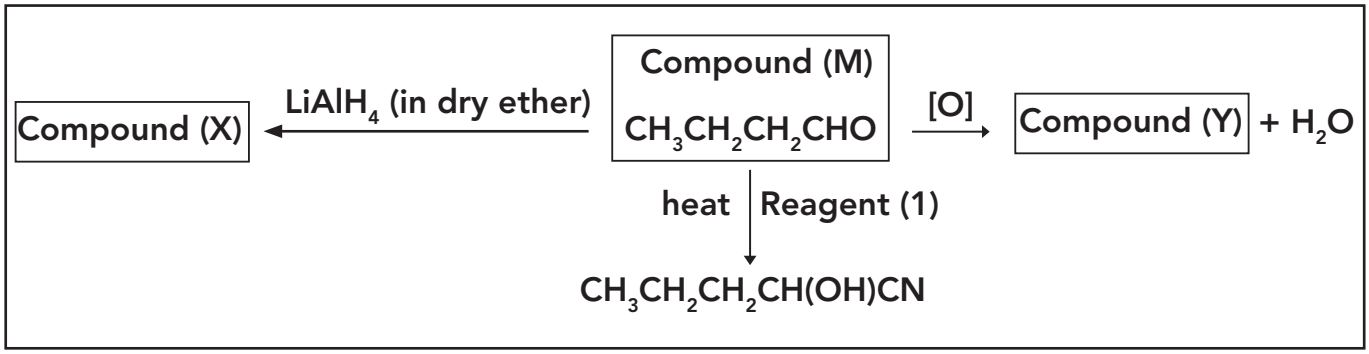
_____ (1 mark)

Explain your answer.

_____

_____ (1 mark)

19) Compound (M) can be converted into three different organic compounds as shown by the reaction scheme below.



a. What is the formula of compound:

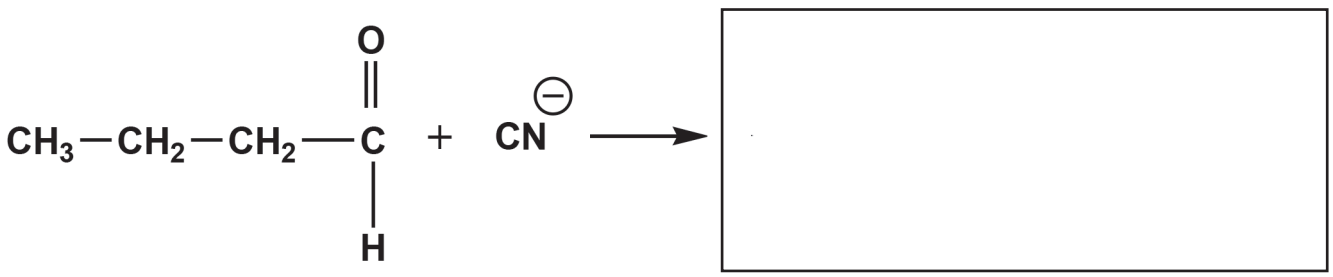
(i) (X): _____ (1 mark)

(ii) (Y): _____ (1 mark)

b. What does the reagent **[O]** represent? _____ (1 mark)

c. (i) State the **reagent (1):** _____ (1 mark)

(ii) Complete the nucleophilic addition of CN^-:



(1 mark)

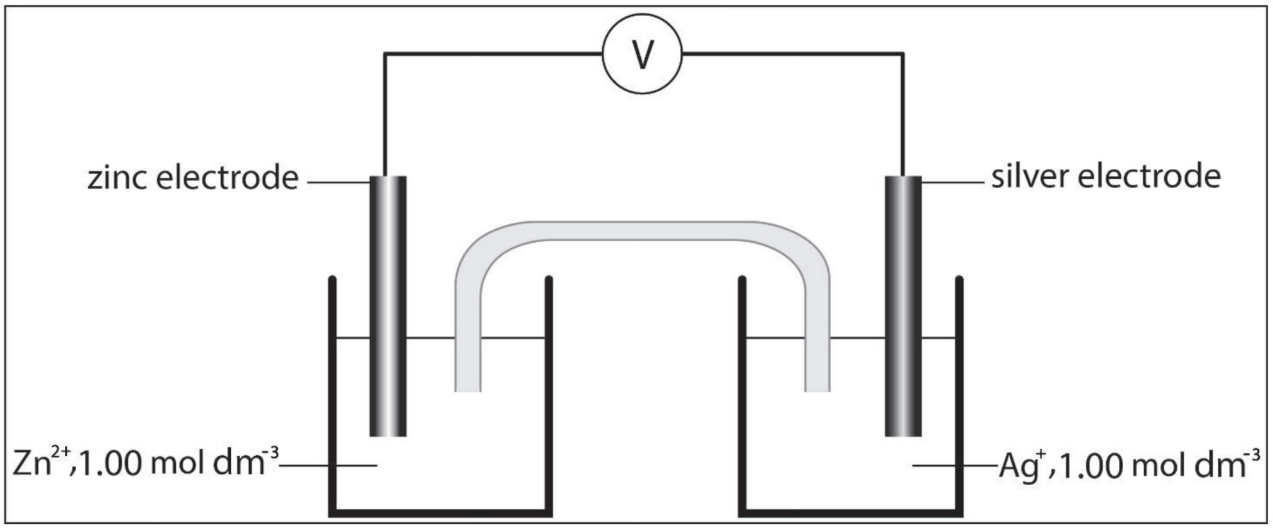
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Question 2 continued

20) The following diagram shows an electrochemical cell.



The values of the standard electrode potential ($E^{\ominus}$) of the half- cell are:

$Ag^{+}(aq) + e^{-} \rightleftharpoons Ag\ (s)$ $\quad E^{\ominus} = +0.80$ V

$Zn^{2+}(aq) + 2e^{-} \rightleftharpoons Zn(s)$ $\quad E^{\ominus} = -0.76$ V

a. Define the standard cell potential.

_____

_____ (1 mark)

b. What is the substance that is:

Oxidized: _____ (1 mark)

Reduced: _____ (1 mark)

c. Calculate the value of the standard cell voltage. **Show your work.**

_____

_____

_____ (2 marks)

d. Write the balanced ionic equation for the overall reaction in the cell.

_____ (1 mark)

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Question 2 continued

e. The Zn^{2+}/Zn half-cell was diluted, while the Ag^{+}/Ag half-cell remained the same. What is the effect of this change on the cell voltage ($E^{\ominus}_{cell}$)?

⬭ Increases ⬭ Decreases **(Shade your answer)**

Explain your answer.

_____

_____

_____

_____ (1 mark)

21) The following reaction is under standard conditions:

$$2Fe^{2+}(aq) + Cl_2(g) \longrightarrow 2Fe^{3+}(aq) + 2Cl^{-}(aq)$$

a. Write the two balanced half equations?

_____

_____ (2 marks)

b. Deduce if the reaction is feasible or not using the standard electrode potential (SEP's).

⬭ Feasible ⬭ Not Feasible **(Shade your answer)**

Explain your answer. _____

_____

_____

_____ (1 mark)

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Question 2 continued

c. The value of the standard electrode potential ($E^{\ominus}$) for a half-cell containing ions ($Fe^{2+}(aq)$) and ($Fe^{3+}(aq)$) is equal to +0.77 V. Using the following equation.

$$E = E^{\ominus} + \frac{0.059}{Z} \log_{10} \frac{[\text{oxidised species}]}{[\text{reduced species}]}$$

Calculate the electrode potential (E), if the ion concentration of $Fe^{2+}(aq)$ is 0.10 mol dm^{-3} and the ion concentration of $Fe^{3+}(aq)$ is 0.02 mol dm^{-3} at 298 K.

_____

_____

_____ (1 mark)

22) The table below shows the standard electrode potential ($E^{\ominus}$) values for five half-equations.

Half-cell equation	$E^{\ominus}$ (V)
$I_2(s) + 2e^- \rightleftharpoons 2I^-(aq)$	+0.54
$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$	+0.34
$Pb^{2+}(aq) + 2e^- \rightleftharpoons Pb(s)$	–0.13
$Co^{2+}(aq) + 2e^- \rightleftharpoons Co(s)$	–0.28
$Al^{3+}(aq) + 3e^- \rightleftharpoons Al(s)$	–1.66

a. Which element is:

(i) The strongest reducing agent?

_____ (1 mark)

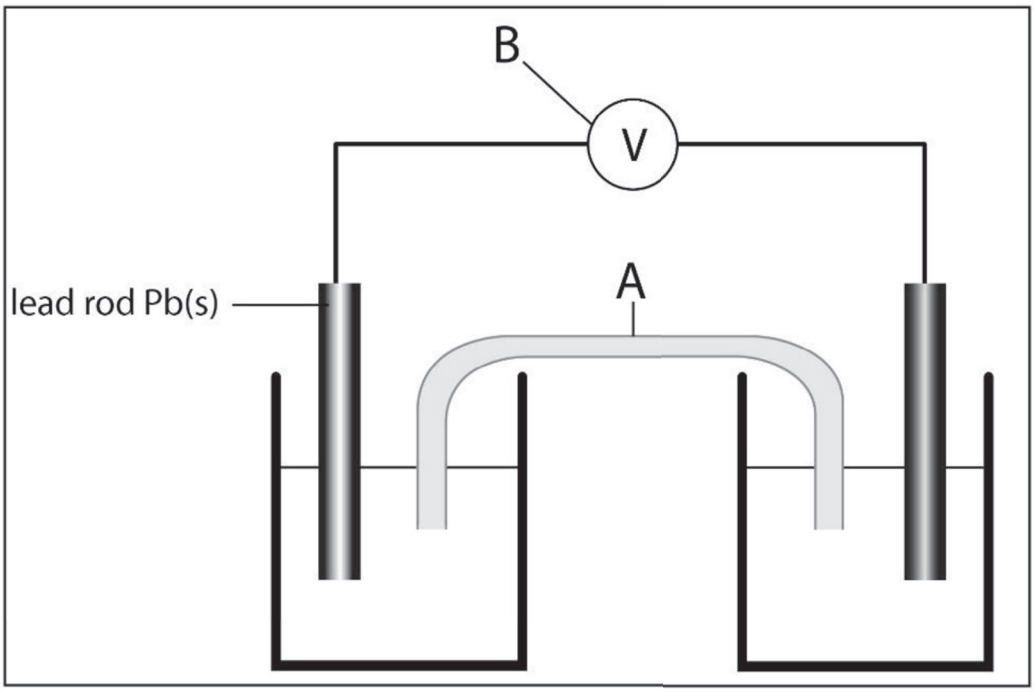
(ii) The easiest to be reduced?

_____ (1 mark)

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Question 2 continued

b. An electrochemical cell is installed as shown in the diagram below.



(i) Name the following parts:

A	B
_____	_____

(2 marks)

(ii) From the table, which one is the appropriate **reactant** to oxidize the metal (Pb) to (Pb^{2+}) and make the value of the **standard cell potential** $E^{\ominus}_{cell}$ **= +0.47 V.**

_____ (1 mark)

c. An electrochemical cell consists of two half-cells (Co and Al), Determine which is the:

Positive electrode: _____ (1 mark)

Negative electrode: _____ (1 mark)

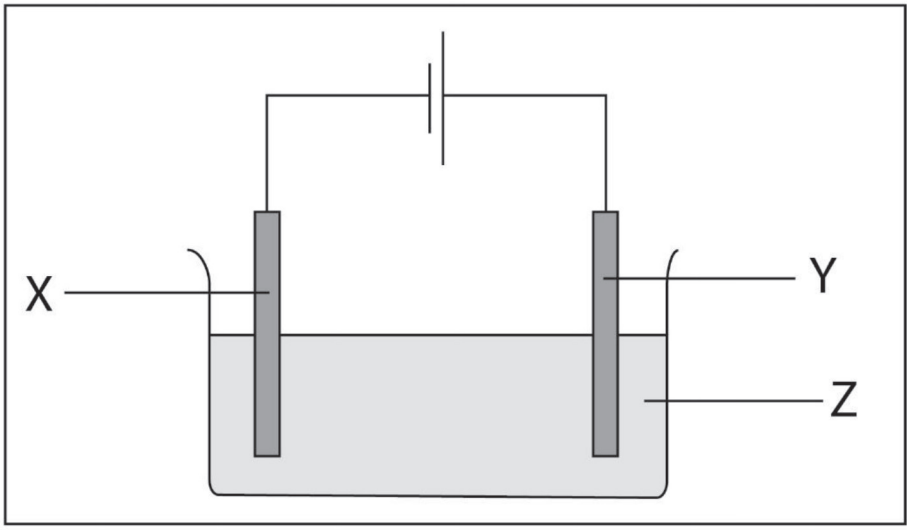
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Question 2 continued

23) The following diagram shows the electrolysis of molten copper chloride.



a. Determine the symbol that represents the:

(i) Cathode: _____ (1 mark)

(ii) Anode: _____ (1 mark)

b. Determine the liberated substance on the:

(i) Cathode: _____ (1 mark)

(ii) Anode: _____ (1 mark)

24) A 20.0 amps current flowed through molten iron(III) chloride ($FeCl_3$) for 5.0 hours (18000 s).

a. Write the half equation at the cathode.

_____ (1 mark)

b. Calculate the number of coulombs (C) used.

_____

_____

_____ (2 marks)

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Question 2 continued

c. Calculate the number of moles of electrons.

(2 marks)

d. Calculate the mass of iron formed at the cathode (Molar mass of iron is 55.8 g mol^{-1}).

(2 marks)

[End of the Examination]

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Selected standard electrode potentials

Electrode reaction	E^{θ}/V
$F_2(g) + 2e^- \leftrightharpoons 2F^-(aq)$	+2.87
$S_2O_8^{2-}(aq) + 2e^- \leftrightharpoons 2SO_4^{2-}(aq)$	+2.01
$H_2O_2(l) + 2H^+(aq) + 2e^- \leftrightharpoons 2H_2O(l)$	+1.77
$MnO_4^-(aq) + 8H^+(aq) + 5e^- \leftrightharpoons Mn^{2+}(aq) + 4H_2O(l)$	+1.52
$PbO_2(s) + 4H^+(aq) + 2e^- \leftrightharpoons Pb^{2+}(aq) + 2H_2O(l)$	+1.47
$Cl_2(g) + 2e^- \leftrightharpoons 2Cl^-(aq)$	+1.36
$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \leftrightharpoons 2Cr^{3+}(aq) + 7H_2O(l)$	+1.33
$O_2(g) + 4H^+(aq) + 4e^- \leftrightharpoons 2H_2O(l)$	+1.23
$Br_2(aq) + 2e^- \leftrightharpoons 2Br^-(aq)$	+1.07
$ClO^-(aq) + H_2O(l) + 2e^- \leftrightharpoons Cl^-(aq) + 2OH^-(aq)$	+0.89
$NO_3^-(aq) + 10H^+(aq) + 8e^- \leftrightharpoons NH_4^+(aq) + 3H_2O(l)$	+0.87
$NO_3^-(aq) + 2H^+(aq) + e^- \leftrightharpoons NO_2(g) + H_2O(l)$	+0.81
$Ag^+(aq) + e^- \leftrightharpoons Ag(s)$	+0.80
$Fe^{3+}(aq) + e^- \leftrightharpoons Fe^{2+}(aq)$	+0.77
$I_2(s) + 2e^- \leftrightharpoons 2I^-(aq)$	+0.54
$Cu^+(aq) + e^- \leftrightharpoons Cu(s)$	+0.52
$S(s) + 2e^- \leftrightharpoons S^{2-}(aq)$	+0.51
$O_2(g) + 2H_2O(l) + 4e^- \leftrightharpoons 4OH^-(aq)$	+0.40
$Cu^{2+}(aq) + 2e^- \leftrightharpoons Cu(s)$	+0.34
$SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \leftrightharpoons SO_2(g) + 2H_2O(l)$	+0.17
$Cu^{2+}(aq) + e^- \leftrightharpoons Cu^+(aq)$	+0.15
$Sn^{4+}(aq) + 2e^- \leftrightharpoons Sn^{2+}(aq)$	+0.15
$S_4O_6^{2-}(aq) + 2e^- \leftrightharpoons 2S_2O_3^{2-}(aq)$	+0.09
$2H^+(aq) + 2e^- \leftrightharpoons H_2(g)$	0.00
$Pb^{2+}(aq) + 2e^- \leftrightharpoons Pb(s)$	-0.13
$Sn^{2+}(aq) + 2e^- \leftrightharpoons Sn(s)$	-0.14
$Ni^{2+}(aq) + 2e^- \leftrightharpoons Ni(s)$	-0.25
$Co^{2+}(aq) + 2e^- \leftrightharpoons Co(s)$	-0.28
$Cd^{2+}(aq) + 2e^- \leftrightharpoons Cd(s)$	-0.40
$Cr^{3+}(aq) + e^- \leftrightharpoons Cr^{2+}(aq)$	-0.41
$Fe^{2+}(aq) + 2e^- \leftrightharpoons Fe(s)$	-0.44
$Cr^{3+}(aq) + 3e^- \leftrightharpoons Cr(s)$	-0.74
$Zn^{2+}(aq) + 2e^- \leftrightharpoons Zn(s)$	-0.76
$2H_2O(l) + 2e^- \leftrightharpoons H_2(g) + 2OH^-(aq)$	-0.83
$Cr^{2+}(aq) + 2e^- \leftrightharpoons Cr(s)$	-0.91
$V^{2+}(aq) + 2e^- \leftrightharpoons V(s)$	-1.20
$Al^{3+}(aq) + 3e^- \leftrightharpoons Al(s)$	-1.66
$Mg^{2+}(aq) + 2e^- \leftrightharpoons Mg(s)$	-2.38
$Na^+(aq) + e^- \leftrightharpoons Na(s)$	-2.71
$Ca^{2+}(aq) + 2e^- \leftrightharpoons Ca(s)$	-2.87
$K^+(aq) + e^- \leftrightharpoons K(s)$	-2.92

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Periodic Table

Atomic number — 11
Element symbol — Na
Mass number — 22.9

1 H 1.01																	2 He 4.00
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 40.00
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226	89 Ac (227)															

Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Actinides	90 Th 232.0	91 Pa (231)	92 U 238	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

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

سلطنة عمان
وزارة التربية والتعليم

MARKING GUIDE

GENERAL EDUCATION DIPLOMA

ROYAL GUARD OF OMAN TECHNICAL COLLEGE

SEMESTER TWO – FIRST SESSION

CHEMISTRY

2024 / 2025

General Education Diploma, Oman Royal Guard Technical College,
Semester Two, First Session, Chemistry, 2024/2025.

Exam Specifications Second Semester for Chemistry Grade 12- First Session / Second Session(2024/2025)

Topic of the Units	Weighting %	Multiple Choice (20%)					Extended Response (80%)					Total Mark
		No. of Questions	Marks	Cognitive Levels			No. of Questions	Marks	Cognitive Levels			
				Knowing (30%)	Applying (50%)	Reasoning (20%)			Knowing (30%)	Applying (50%)	Reasoning (20%)	
Alcohols and carboxylic acids	31 %	14	4	1	2	1	10	18	5	9	4	22
Carbonyl Compounds	15 %		2	1	1	-		9	3	4	2	11
Electrochemistry	54 %		8	2	4	2		29	9	15	5	37
Total	100%		14	4	7	3		56	17	28	11	70

General Education Diploma, Oman Royal Guard Technical College,
Semester Two, First Session, Chemistry, 2024/2025.

Distribution of cognitive domains and marks.

QUESTION ONE: Multiple choice (14 marks)

Item	Mark	Unit	page	Cognitive domain	Output
1	1	Alcohols and Carboxylic acids	22	Knowledge	4.2.b.iv
2	1	Alcohols and Carboxylic acids	13	Application	4.1.c.ii
3	1	Alcohols and Carboxylic acids	21	Application	4.2.b.ii
4	1	Alcohols and Carboxylic acids	7-8	Reasoning	4.1.a
5	1	Carbonyl compounds	30	Knowledge	5.1.a.i
6	1	Carbonyl compounds	32	Application	5.1.a.ii
7	1	Electrochemistry	56-65	Application	6.1.g
8	1	Electrochemistry	69-70	Reasoning	6.1.j
9	1	Electrochemistry	53-54	Knowledge	6.1.d
10	1	Electrochemistry	53-70	Application	6.1.h
11	1	Electrochemistry	66-69	Application	6.1.i
12	1	Electrochemistry	81	Applying	6.2.a
13	1	Electrochemistry	81	Knowing	6.2.b
14	1	Electrochemistry	81-86	Reasoning	6.2.a

QUESTION TWO: Extended response (56 marks)

Item	Mark	Unit	Page	Cognitive domain	Output
15.a.i	1	Alcohols and Carboxylic acids	11	Applying	4.1.b.iv
15.a.ii	1	Alcohols and Carboxylic acids	11	Knowing	4.1.b.iv
15.b.i	1	Alcohols and Carboxylic acids	11	Applying	4.1.b.iv
15.b.ii	1	Alcohols and Carboxylic acids	18-20	Reasoning	4.2.b.v
15.c	3	Alcohols and Carboxylic acids	11 7-8 20	Reasoning + Applying + Applying	4.1.b.iv 4.1.a 4.2.a.iii
16.a.i	1	Alcohols and Carboxylic acids	9	Knowing	4.1.b.i
16.a.ii	2	Alcohols and Carboxylic acids	9	Knowing	4.1.b.i
16.a.iii	1	Alcohols and Carboxylic acids	7-8	Applying	4.1.a
16.a.iv	1	Alcohols and Carboxylic acids	7-8	Applying	4.1.a
16.b	1	Alcohols and Carboxylic acids	10	Applying	4.1.b.ii
17.a.i	1	Alcohols and Carboxylic acids	18	Knowing	4.2.a.i
17.a.ii	2	Alcohols and Carboxylic acids	18	Applying	4.2.a.i
17.b.i	2	Alcohols and Carboxylic acids	21	Reasoning	4.2.b.i
18.a	1	Carbonyl Compounds	34-35	Knowing	5.1.c
18.b	1	Carbonyl Compounds	35	Knowing	5.1.c
18.c	2	Carbonyl Compounds	35	Knowing + Reasoning	5.1.c
19.a.i	1	Carbonyl Compounds	32	Applying	a.ii
19.a.ii	1	Carbonyl Compounds	30	Applying	a.i

19.b	1	Carbonyl Compounds	30	Applying	a.i
19.c.i	1	Carbonyl Compounds	32-34	Applying	a.ii
19.c.ii	1	Carbonyl Compounds	32-34	Reasoning	a.ii
20.a	1	Electrochemistry	55	Knowledge	6.1.a.i
20.b	2	Electrochemistry	51	Knowledge	6.1.j
20.c	2	Electrochemistry	56-65	Application	6.1.g
20.d	1	Electrochemistry	61	Knowledge	6.1.k
20.e	1	Electrochemistry	71-73	Reasoning	6.1.l
21.a	2	Electrochemistry	46-60	Applying	6.1.b, f.i
21.b	1	Electrochemistry	61-65	Reasoning	6.1.h.ii
21.c	1	Electrochemistry	73-75	Application	6.1.m
22.a.i	1	Electrochemistry	71-73	Application	6.1.j
22.a.ii	1	Electrochemistry	71-73	Application	6.1.j
22.b.i	2	Electrochemistry	45-48	Knowledge	6.1.c
22.b.ii	1	Electrochemistry	45-61	Reasoning	6.1.g, h.i, j
22.c	2	Electrochemistry	61-65	Application	6.1.h.i
23.a.i	1	Electrochemistry	76-78	Knowing	6.2.a
23.a.ii	1	Electrochemistry	76-78	Knowing	6.2.a
23.b.i	1	Electrochemistry	76-78	Applying	6.2.a
23.b.ii	1	Electrochemistry	76-78	Applying	6.2.a
24.a	1	Electrochemistry	79-81	Applying	6.2.a
24.b	2	Electrochemistry	82-84	Knowing + Applying	6.2.c.i
24.c	2	Electrochemistry	82-86	Applying	6.2.c.i
24.d	2	Electrochemistry	83-84	Reasoning	6.2.c.ii

General Education Diploma, Oman Royal Guard Technical College,
Semester Two, First Session, Chemistry, 2024/2025.

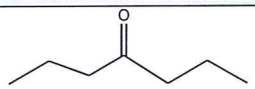
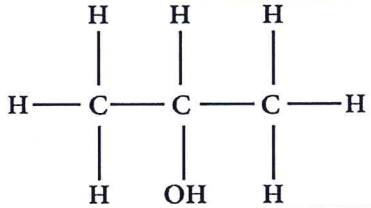
TOTAL MARKS: 70 **PAGES: 8**

Question One (14 Marks)

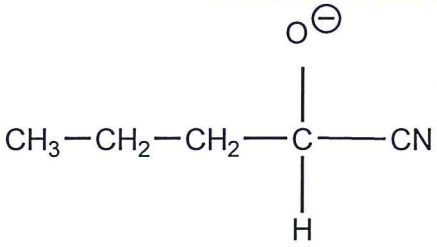
There are 14 multiple-choice items. Each correct answer is worth ONE mark.

Item	Correct option	
1	c	Strong acid
2	b	$SOCl_2$
3	c	HCOOH + NaOH | $HCOONa + H_2O$
4	d	2-methylbutan-2-ol | Tertiary
5	d	$K_2Cr_2O_7$
6	d	$CH_3CH_2CH_2CH_2OH$
7	a	+0.46
8	a	Cu^+
9	a	It represents the anode in all electrolytic cells.
10	b	H^+ ions gain electrons more easily than Ni^{2+} ions.
11	c	Reduction of Fe^{2+}.
12	c	$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$
13	a	Faraday's Law.
14	b	Cu | O_2

Question Two (56 Marks)

<table>
<tr><th>Part</th><th>Section</th><th>The answer</th><th>The mark</th></tr>
<tr><td rowspan="6">15</td><td>a.i</td><td>B or </td><td>1</td></tr>
<tr><td>a.ii</td><td>$NaBH_4$</td><td>1</td></tr>
<tr><td>b.i</td><td>D</td><td>1</td></tr>
<tr><td>b.ii</td><td>C</td><td>1</td></tr>
<tr><td>c</td><td><table><tr><th>Statement (description)</th><th>Symbol</th></tr><tr><td>A compound that is reduced to form a primary alcohol.</td><td>A</td></tr><tr><td>A compound that is classified as a tertiary alcohol.</td><td>F</td></tr><tr><td>A compound that can be produced by hydrolysing esters.</td><td>E</td></tr></table></td><td>3</td></tr>
<tr><td rowspan="5">16</td><td>a.i</td><td>H_3PO_4</td><td>1</td></tr>
<tr><td>a.ii</td><td>350 C
60 atm
One mark for each.
(Note: Accept high temperature (T) and high pressure (P))</td><td>2</td></tr>
<tr><td>a.iii</td><td></td><td>1</td></tr>
<tr><td>a.iv</td><td>Secondary alcohol.</td><td>1</td></tr>
<tr><td>b</td><td>Propane-1,2-diol</td><td>1</td></tr>
</table>

Part	Section	The answer	The mark
17	a.i	Acidified $K_2Cr_2O_7$ **Or** Acidified $KMnO_4$	1
	a.ii	Compound (Y): $CH_3CH_2CH_2CH_2OH$	1
		Compound (Z): $CH_3CH_2CH_2COOH$	1
	b	Reaction1: NaOH Or KOH (Note: accept another alkalis)	1
		Reaction2: Na Or Mg Or any other reactive metal that the student writes.	1
18	a	- Fehling solution is used **to distinguish between aldehydes and ketones.**	1
	b	- **The blue colour** of the solution **changes to red/orange as a precipitate** of copper oxide is formed - Or, Blue solution → **red/orange precipitate is formed** - Or, **Precipitate is formed**	1
	c	- **RCHO** or **HCHO** or any formula of **aldehyde**.	1
		- Explaining: - Fehling solution contains the **Cu^{2+} ions that oxidize aldehyde** to its carboxylic acid. - Or, **Cu^{2+} oxidize aldehyde** to its carboxylic acid. - Or, **The Cu^{2+} ions are reduced to Cu^{+}** - Or, **$Cu^{2+} + e^{-} \rightarrow Cu^{+}$** - Or, **Reduction reaction happened**.	1

Part	Section	The answer	The mark
19	a.i	(X): $CH_3CH_2CH_2CH_2OH$	1
	a.ii	(Y): $CH_3CH_2CH_2COOH$	1
	b	$K_2Cr_2O_7$, $KMnO_4$	1
	c.i	HCN	1
	c.ii		1

Part	Section	The answer	The mark
20	a	The potential difference when two standard half- cells are connected under conditions (of 298K, 1 atm and all solutions at 1M)	1
	b	Oxidized: Zn Reduced: Ag^+	1 1
	c	$\mathbf{E^{\theta}_{cell} = E^{\theta}_{r}\ reduction - E^{\theta}_{r}\ oxidation}$ $E^{\theta}_{cell} = 0.80 - (-0.76)$ $= \mathbf{+1.56\ V}$	1 1
	d	$Zn(s) + 2Ag^+(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$	1
	e	The cell voltage **increases**, Because diluting the solution concentration in the Zn^{2+}/Zn half-cell results in a lower E_r value. Consequently, the difference between the two half-cell voltages increases.	1

Part	Section	The answer	The mark
21	a	$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-(aq)$ $Fe^{2+}(aq) \rightleftharpoons Fe^{3+}(aq) + e^-$ Or $2Fe^{2+}(aq) \rightleftharpoons 2Fe^{3+}(aq) + 2e^-$ (Note: one mark for each)	1 1
	b	It is **feasible** because, $E^{\theta}_{cell} = E^{\theta}_{r}\ \text{reduction} - E^{\theta}_{r}\ \text{oxidation}$ $E^{\theta}_{cell} = 1.36 - (0.77)$ $= +0.59\ V$ The value of standard cell potential (E^{θ}_{cell}) is positive **Or** Cl_2 is the strongest oxidizing agent; This is because its E^{θ}_{r} value is greater, and therefore Cl_2 molecules are able to gain electrons more easily than Fe^{3+} ions. **Or** Fe^{2+} is the strongest reducing agent; This is because its E^{θ}_{r} value is lower, so Fe^{2+} ions lose electrons more easily than Cl^- ions. **Or** The stronger oxidizing agent reacts with the stronger reducing agent, meaning that the reaction can occur (feasible).	1
	c	$E_r = O.77 + \frac{0.059}{1}\log_{10}\frac{[0.02]}{[0.10]}$ **= 0.73 V Or 0.729 V** **Note:** The student gets full mark if he/she writes the final answer.	1

Part	Section	The answer	The mark
22	a.i	Al	1
	a.ii	I_2	1
	b.i	- A salt bridge - B voltmeter	1 1
	b.ii	Cu^{2+}	1
	c	- positive electrode (Co^{2+}/Co) - negative electrode (Al/ Al^{3+})	1 1
23	a.i	X	1
	a.ii	Y	1
	b.i	Copper **or** Cu **or** Cu^+	1
	b.ii	Chlorine **or** Cl_2	1

Part	Section	The answer	The mark
24	a	$Fe^{3+} + 3e^- \rightarrow Fe_{(s)}$	1
	b	$Q = I \times t$ $Q = 20.0 \text{ amps} \times 18000 \text{ s} = 360000$ $= \mathbf{3.6 \times 10^5}$ **coulombs (C)**	1 1
	c	Step (1): $96500\ coulombs = 1\ Faraday$ $3.6 \times 10^5\ coulombs = (\text{X})\ Faraday$ $(\text{x}) = (3.6 \times 10^5)C \times \frac{1\ F}{96{,}500\ C} =$ **3.73 *Faraday*** ***Or*** ***3.7306 Faraday*** Step (2) $1\ Farady = 1\ mole\ of\ electrons$ $3.73\ Faraday = (\text{y})mol\ e^-$ $(\text{y})mol\ e^- = 3.73\ Faraday \times \frac{1\ mole\ of\ electrons}{1\ Farady} =$ **$3.73\ mol\ e^-$** Or **$3.7306\ mol\ e^-$**	1 1
	d	According to the half equation at the cathode, three moles of electrons produce one mole of iron, $3.73\ mol\ e^- \times \frac{1\ mol\ of\ Fe}{3\ mol\ e^-} =$ **$1.24\ mol$** ***Or*** **$1.2435\ mol$** By using the molar mass of iron $1.24\ mol\ of\ Fe \times \frac{55.8\ g}{1\ mol} =$ **$69.19\ g$** ***Or*** **$69.387 g$**	1 1

This is the end of the Marking Guide





امتحان دبلوم التعليم العام

لكلية الحرس السلطاني العماني التقنية (ثنائية اللغة)

الفصل الدراسي الثاني - الدور الثاني - للعام الدراسي ١٤٤٦ /١٤٤٧ هـ - ٢٠٢٤ / ٢٠٢٥ م

تنبيه:
- المادة: الكيمياء.
- الأسئلة في (١٣) صفحة.
- زمن الإجابة: ثلاث ساعات.
- الإجابة في الورقة نفسها.

تعليمات مهمة:

- يجب الحضور إلى قاعة الامتحان قبل عشر دقائق على الأقل من بدء زمن الامتحان.
- يجب إحضار أصل ما يثبت الهوية وإبرازها للعاملين بالامتحانات.
- يجب الالتزام بالزي (الدشداشة البيضاء والمصر أو الكمة للذكور) والزي المدرسي للطالبات ، ويستثنى من ذلك الدارسون من غير العمانيين بشرط الالتزام بالذوق العام، ويمنع على جميع المتقدمات ارتداء النقاب داخل المركز وقاعات الامتحان.
- يحظر على الممتحنين اصطحاب الهواتف النقالة وأجهزة النداء الآلي وآلات التصوير والحواسيب الشخصية والساعات الرقمية الذكية والآلات الحاسبة ذات الصفة التخزينية والمجلات والصحف والكتب الدراسية والدفاتر والمذكرات والحقائب اليدوية والآلات الحادة أو الأسلحة أياً كان نوعها وأي شيء له علاقة بالامتحان.
- يجب على الممتحن الامتثال لإجراءات التفتيش داخل المركز طوال أيام الامتحان.
- يجب على الممتحن التأكد من استلام دفتر امتحانه، مغلفاً بغلاف بلاستيكي شفاف وغير ممزق ، وهو مسؤول عنه حتى يسلمه لمراقبي اللجنة بعد الانتهاء من الإجابة.
- يجب الالتزام بضوابط إدارة امتحانات دبلوم التعليم العام وما في مستواه وأية مخالفة لهذه الضوابط تعرضك للتدابير والإجراءات والعقوبات المنصوص عليها بالقرار الوزاري رقم ٥٨٨ / ٢٠١٥.
- يقوم المتقدم بالإجابة عن أسئلة الامتحان المقالية بقلم الحبر (الأزرق أو الأسود).
- يقوم المتقدم بالإجابة عن أسئلة الاختيار من متعدد بتظليل الشكل (○) وفق النموذج الآتي:

س – عاصمة سلطنة عمان هي:

○ القاهرة ○ الدوحة

● مسقط ○ أبوظبي

ملاحظة: يتم تظليل الشكل (●) باستخدام القلم الرصاص وعند الخطأ، امسح بعناية لإجراء التغيير.

صحيح ● **غير صحيح** ▭ ◉ ◒ ☒ ☑

مُسَوَّدَة، لا يتم تصحيحها

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Question 1: Multiple Choice Items (14 marks)

There are 14 multiple-choice items worth one mark each.
Shade in the bubble (⬭) next to the **correct** answer for each of the following items.

1) Which homologous series compounds form secondary alcohols when reduced?

⬭ Esters
⬭ Ketones
⬭ Aldehydes
⬭ Carboxylic acids

2) What are the missing products in this reaction equation?

$2CH_3CH_2COOH + K_2CO_3 \longrightarrow 2CH_3CH_2COOK +$ _____ + _____

⬭ $H_2 + CO$
⬭ $H_2 + CO_2$
⬭ $H_2O + CO$
⬭ $H_2O + CO_2$

3) What is the product when 1-chloropentane reacts with NaOH?

⬭ Pentan-1-ol
⬭ Pentane-1,2-diol
⬭ 1-Chloropentan-1-ol
⬭ 1-Chloropentan-2-ol

4) Which of the following functional groups should be present in the products when HCOOH reacts with methanol?

⬭ -OH
⬭ -CHO
⬭ -COOR
⬭ -COOH

5) Which reagent can be used to oxidize primary alcohols to form aldehydes?

⬭ $SOCl_2$
⬭ $LiAlH_4$
⬭ $NaBH_4$
⬭ $K_2Cr_2O_7$

6) Which of the following compounds gives a positive Fehling's solution test?

⬭ $CH_3CH_2COCH_3$
⬭ $CH_3CH_2CH_2CHO$
⬭ $CH_3CH_2CH_2COOH$
⬭ $CH_3CH_2CH_2CH_2OH$

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Question 1 continued

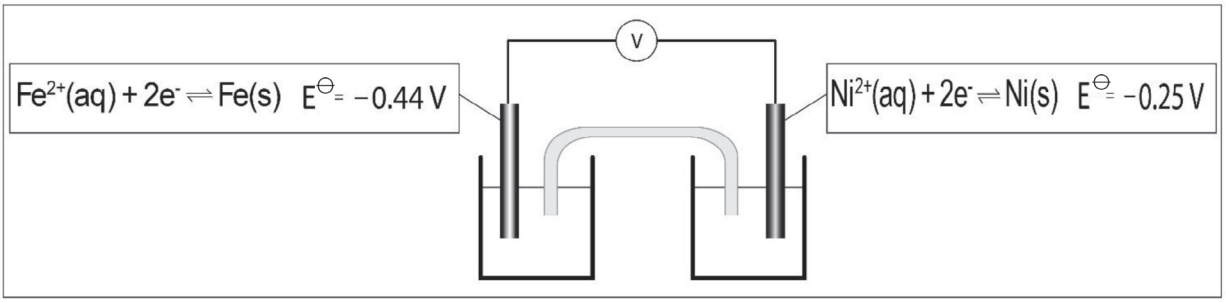
7) What is the standard cell potential ($E^{\ominus}_{cell}$) in volt (V) for the ionic equation given below?

$$Zn(s) + 2Ag^{+}(aq) \longrightarrow Zn^{2+}(aq) + 2Ag(s)$$

Half- cell equation	$E^{\ominus}$ (V)
$Ag^{+}(aq) + e^{-} \rightleftharpoons Ag(s)$	+0.80
$Zn^{2+}(aq) + 2e^{-} \rightleftharpoons Zn(s)$	−0.76

- ☐ +1.56
- ☐ −1.56
- ☐ +0.04
- ☐ −0.04

8) Which of the following options is correct about this cell?



	(+) Electrode	Direction of electron flow
☐	Fe	From Fe to Ni
☐	Fe	From Ni to Fe
☐	Ni	From Fe to Ni
☐	Ni	From Ni to Fe

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Question 1 continued

9) Which of the following is **not** a condition for the standard hydrogen electrode (SHE)?

- ☐ Platinum electrodes
- ☐ Temperature of 298 K
- ☐ Concentration of 1.00 mol dm^{-3}
- ☐ Hydrogen gas with a pressure of 100 Pa

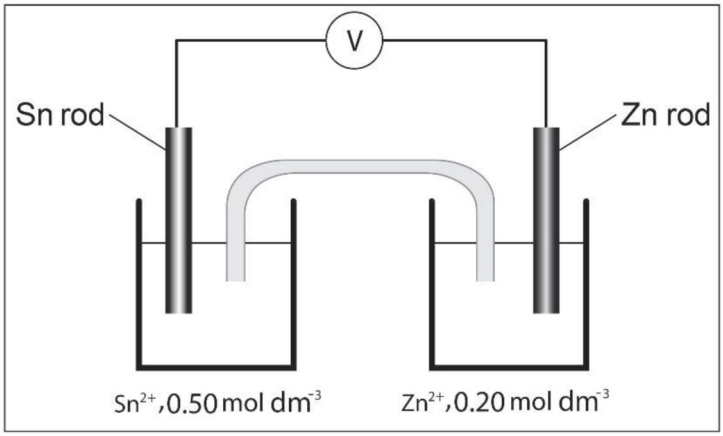
10) Consider the following electrochemical cell.

$$Zn(s) + Cu^{2+}(aq) \rightleftharpoons Cu(s) + Zn^{2+}(aq)$$

When the cell is running spontaneously, which option is correct?

	Electrode	Mass
☐	Cu (anode)	Lose
☐	Cu (cathode)	Gain
☐	Zn (anode)	Gain
☐	Zn (cathode)	Lose

11) The following diagram shows an electrochemical cell. What is the value (E_{cell}) of this cell if ($E^{\ominus}_{cell}$ = +0.62V)?



- ☐ 0.632
- ☐ 0.658
- ☐ 0.661
- ☐ 0.682

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Question 1 continued

12) What is the half-equation for the reaction at the anode during the electrolysis of a concentrated aqueous solution of (NaCl)?

- ☐ $Na^+ + e^- \longrightarrow Na$
- ☐ $2Cl^- \longrightarrow Cl_2 + 2e^-$
- ☐ $2H^+ + 2e^- \longrightarrow H_2$
- ☐ $4OH^- \longrightarrow O_2 + 2H_2O + 4e^-$

13) What is the quantity of charge in coulombs when 0.17 A flows through a solution of silver nitrate for 50 minutes?

- ☐ 8.5
- ☐ 294
- ☐ 510
- ☐ 612

14) How many grams of copper is deposited during the electrolysis of an aqueous solution of $CuSO_4$, when passing one mole of electrons through a copper cell?

- ☐ 31.78
- ☐ 63.55
- ☐ 79.75
- ☐ 127.10

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Question 2: Extended responses (56 marks)

Write your answer for each of the following questions in the space provided.
Be sure to show all your work, including the correct units where applicable.

15) Carboxylic acids such as butanoic acid can be formed by a hydrolysis reaction.
Two different hydrolysis reactions equations are shown below.

Reaction 1: Compound (X) + HCl + $2H_2O$ ⟶ Butanoic acid + NH_4Cl

Reaction 2: Compound (Y) + H_2O $\xrightarrow{H^+}$ Butanoic acid + $CH_3CH_2CH_2OH$

a. Name one condition for these reactions _____ (1 mark)

b. What is the structural formula of compound:

(i) (X): _____ (1 mark)

(ii) (Y): _____ (1 mark)

c. What is the reaction that is used to produce butanoic acid from butanal?

_____ (1 mark)

d. Use the following equation to complete the table.

Butanoic acid + A ⟶ Salt + B

A	B
Potassium	_____
KOH	_____
Na_2CO_3	_____ + _____

(3 marks)

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Question 2 continued

16) Study the oxidation reaction equation below to answer the following questions.

$$CH_3CH_2CH_2OH \longrightarrow (Y) \longrightarrow (Z)$$

a. For the compound propan-1-ol:

(i) Draw the displayed formula.

(1 mark)

(ii) Classify the previous alcohol.

_____ (1 mark)

b. Write the structural formula for compounds:

(i) (Y): _____ (1 mark)

(ii) (Z): _____ (1 mark)

c. Name an oxidizing agent other than the acidified $K_2Cr_2O_7$ that has the same effect on this reaction.

_____ (1 mark)

d. Write the combustion reaction equation of propan-1-ol.

_____

_____(2 marks)

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Question 2 continued

17) Study the following substitution reaction equation.

$$CH_3CH_2CH_2CH_2CH_2CH_2Br + NaOH \longrightarrow X + NaBr$$

a. What is the condition that must be present for this reaction to occur?

_____ (1 mark)

b. What is the homologous series that compound (X) belongs to?

_____ (1 mark)

c. What is the homologous series of the produced compound from:

(i) Dehydrating compound (X) with a heated catalyst.

_____ (1 mark)

(ii) Reacting compound (X) with HBr in concentrated H_2SO_4.

_____ (1 mark)

18) A Tollen reagent is a mixture of excess ammonia solution and silver nitrate.

a. What is the use of the Tollen reagent?

_____

_____ (1 mark)

b. What is the observation you expect to see in a positive Tollen's test?

_____

_____ (1 mark)

c. What is the oxidizing agent?

_____ (1 mark)

d. Which compound reacts with a Tollen solution?

☐ CH_3CH_2CHO ☐ CH_3COCH_3 **(Shade your answer)**

Explain.

_____

_____ (1 mark)

Do not write in this space

Question 2 continued

19) Compound (R) and compound (S) are both carbonyl compounds. They were tested with acidified $K_2Cr_2O_7$ and Fehling's solution test as shown in the table below.

	Compound (R)	Compound (S)
$K_2Cr_2O_7/H^+$	green solution	No reaction
Fehling's reagent	red/orange precipitate	

Study the table above, and answer the questions below:

a. What is the general formula of:

(i) Compound (R):

_____ (1 mark)

(ii) Compound (S):

_____ (1 mark)

b. Write the general formula of the product in each reaction:

(i) Compound (R) + 2[H] $\xrightarrow{LiAlH_4 \text{ (in dry ether)}}$ _____ (1 mark)

(ii) Compound (S) + 2[H] $\xrightarrow{LiAlH_4 \text{ (in dry ether)}}$ _____ (1 mark)

c. Complete the following reaction.

$$CH_3CHO + \boxed{} \xrightarrow{\text{Heat}} CH_3CH(OH)CN$$

(1 mark)

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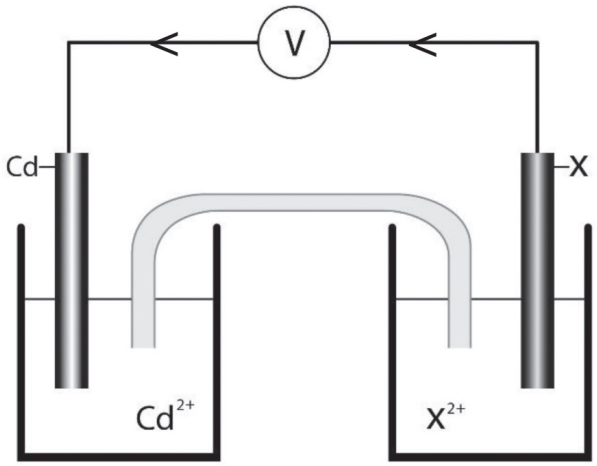
Question 2 continued

20) The table below shows the standard electrode potentials ($E^{\ominus}$) of some half-cells.

Half-cell	Cd/Cd^{2+}	Cr/Cr^{2+}	Ni/Ni^{2+}	Cu/Cu^{2+}
$E^{\ominus}$ (V)	-0.40	-0.91	-0.25	-0.34

a. Which metal can be used instead of the (x) rod to move the electrons as shown in the diagram below?

_____ (1 mark)



b. An electrochemical cell consists of two half-cells (Ni/Ni^{2+} and Cu/Cu^{2+}).

(i) Define the standard cell potential ($E^{\ominus}_{cell}$).

_____

_____ (1 mark)

(ii) Write the balanced ionic equation for the overall reaction in the cell?

_____ (1 mark)

(iii) Which electrode will gain mass?

_____ (1 mark)

(iv) Calculate the standard cell potential ($E^{\ominus}_{cell}$).

_____

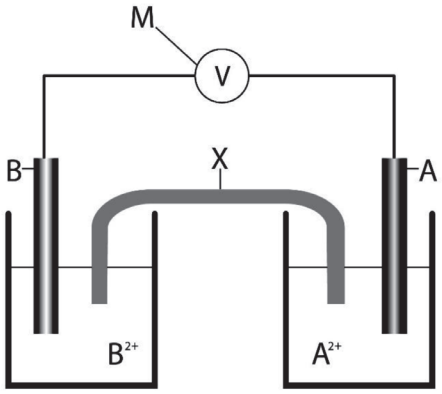
_____

_____ (2 marks)

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Question 2 continued

21) The following electrochemical cell was used under standard conditions in four different experiments as shown in the table below.



Experiment number	Electrode (A)	Electrode (B)
1	Pb	Zn
2	Sn	Ni
3	Zn	Sn
4	Pb	Ni

a. Name the following parts:

- X: _____
- M: _____ (2 marks)

Use standard electrode potentials to answer the following questions:

b. Which electrode (A or B) is the positive in Experiment (1)?

_____ (1 mark)

c. State the direction of movement of electrons in the external circuit for Experiment (2).

_____ (1 mark)

d. Which electrode (A or B) will lose mass in Experiment (3)?

_____ (1 mark)

e. Write the equation for the half-reaction that occurs at electrode (A) in Experiment (4)?

_____ (1 mark)

f. In experiment (4), does Ni reduce Pb^{2+} to Pb.

☐ Yes ☐ No **(Shade your answer)**

Explain.

_____

_____

_____ (1 mark)

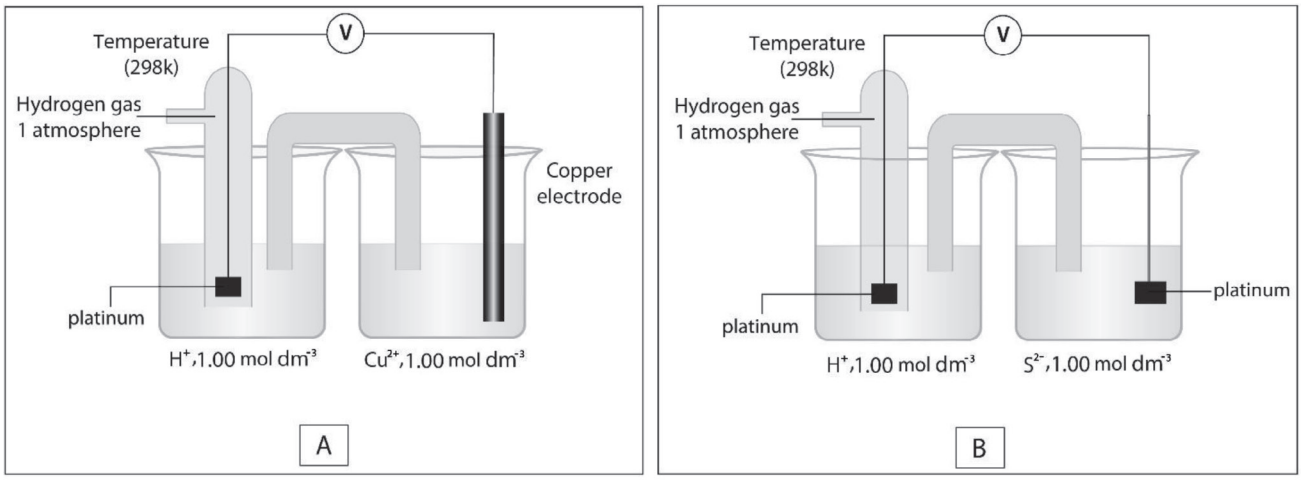
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Question 2 continued

22) The following diagrams show two electrochemical cells designed to find the standard electrode potential ($E^{\ominus}$) for copper and sulfur.



a. Define the standard electrode potential ($E^{\ominus}$).

_____

_____ (1 mark)

b. Write the two half equations for the cell (A)?

_____

_____(2 marks)

c. For cell B,

(i) Which is the positive half- cell?

_____

Explain.

_____

_____

_____(1 mark)

(ii) Calculate the standard cell potential ($E^{\ominus}_{cell}$)?

_____

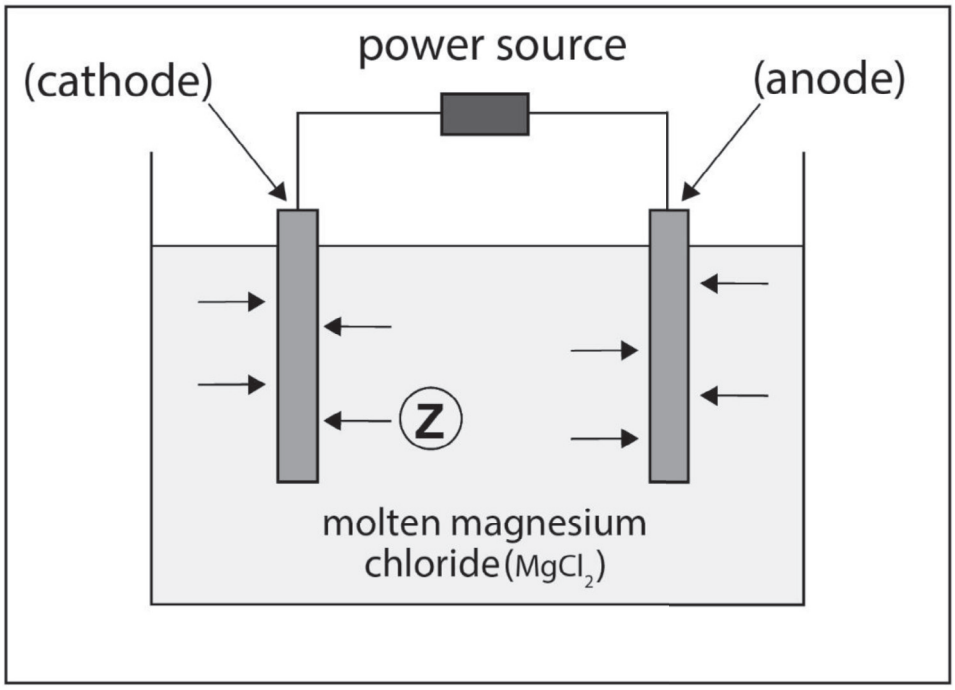
_____

_____(1 mark)

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Question 2 continued

23) The diagram below shows a circuit used to electrolyze a molten of magnesium chloride ($MgCl_2$).



a. State three factors that help to predict the identities of substances liberated during electrolysis.

_____

_____

_____ (3 marks)

b. Write each ionic half-equation.

_____

_____ (2 marks)

c. What is (Z) representing in the diagram above?

_____ (1 mark)

d. What is the gas produced from this cell?

_____ (1 mark)

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Question 2 continued

24) The amount of electricity supplied to an electrolytic cell to produce 0.100 Kg of iron from iron(III) oxide.

a. Calculate the number of moles of iron produced.

_____

_____ (1 mark)

b. Write the half-reaction of the reduction of iron(III) oxide to iron.

_____ (1 mark)

c. Calculate the total number of moles of electrons needed.

_____

_____ (1 mark)

d. What is the amount of charge needed to produce 0.100 Kg of iron? (Faraday's constant is 96500 C).

_____

_____ (1 mark)

[End of the Examination]

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Selected standard electrode potentials

Electrode reaction	E^{θ}/V
$F_2(g) + 2e^- \leftrightharpoons 2F^-(aq)$	+2.87
$S_2O_8^{2-}(aq) + 2e^- \leftrightharpoons 2SO_4^{2-}(aq)$	+2.01
$H_2O_2(l) + 2H^+(aq) + 2e^- \leftrightharpoons 2H_2O(l)$	+1.77
$MnO_4^-(aq) + 8H^+(aq) + 5e^- \leftrightharpoons Mn^{2+}(aq) + 4H_2O(l)$	+1.52
$PbO_2(s) + 4H^+(aq) + 2e^- \leftrightharpoons Pb^{2+}(aq) + 2H_2O(l)$	+1.47
$Cl_2(g) + 2e^- \leftrightharpoons 2Cl^-(aq)$	+1.36
$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \leftrightharpoons 2Cr^{3+}(aq) + 7H_2O(l)$	+1.33
$O_2(g) + 4H^+(aq) + 4e^- \leftrightharpoons 2H_2O(l)$	+1.23
$Br_2(aq) + 2e^- \leftrightharpoons 2Br^-(aq)$	+1.07
$ClO^-(aq) + H_2O(l) + 2e^- \leftrightharpoons Cl^-(aq) + 2OH^-(aq)$	+0.89
$NO_3^-(aq) + 10H^+(aq) + 8e^- \leftrightharpoons NH_4^+(aq) + 3H_2O(l)$	+0.87
$NO_3^-(aq) + 2H^+(aq) + e^- \leftrightharpoons NO_2(g) + H_2O(l)$	+0.81
$Ag^+(aq) + e^- \leftrightharpoons Ag(s)$	+0.80
$Fe^{3+}(aq) + e^- \leftrightharpoons Fe^{2+}(aq)$	+0.77
$I_2(s) + 2e^- \leftrightharpoons 2I^-(aq)$	+0.54
$Cu^+(aq) + e^- \leftrightharpoons Cu(s)$	+0.52
$S(s) + 2e^- \leftrightharpoons S^{2-}(aq)$	+0.51
$O_2(g) + 2H_2O(l) + 4e^- \leftrightharpoons 4OH^-(aq)$	+0.40
$Cu^{2+}(aq) + 2e^- \leftrightharpoons Cu(s)$	+0.34
$SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \leftrightharpoons SO_2(g) + 2H_2O(l)$	+0.17
$Cu^{2+}(aq) + e^- \leftrightharpoons Cu^+(aq)$	+0.15
$Sn^{4+}(aq) + 2e^- \leftrightharpoons Sn^{2+}(aq)$	+0.15
$S_4O_6^{2-}(aq) + 2e^- \leftrightharpoons 2S_2O_3^{2-}(aq)$	+0.09
$2H^+(aq) + 2e^- \leftrightharpoons H_2(g)$	0.00
$Pb^{2+}(aq) + 2e^- \leftrightharpoons Pb(s)$	-0.13
$Sn^{2+}(aq) + 2e^- \leftrightharpoons Sn(s)$	-0.14
$Ni^{2+}(aq) + 2e^- \leftrightharpoons Ni(s)$	-0.25
$Co^{2+}(aq) + 2e^- \leftrightharpoons Co(s)$	-0.28
$Cd^{2+}(aq) + 2e^- \leftrightharpoons Cd(s)$	-0.40
$Cr^{3+}(aq) + e^- \leftrightharpoons Cr^{2+}(aq)$	-0.41
$Fe^{2+}(aq) + 2e^- \leftrightharpoons Fe(s)$	-0.44
$Cr^{3+}(aq) + 3e^- \leftrightharpoons Cr(s)$	-0.74
$Zn^{2+}(aq) + 2e^- \leftrightharpoons Zn(s)$	-0.76
$2H_2O(l) + 2e^- \leftrightharpoons H_2(g) + 2OH^-(aq)$	-0.83
$Cr^{2+}(aq) + 2e^- \leftrightharpoons Cr(s)$	-0.91
$V^{2+}(aq) + 2e^- \leftrightharpoons V(s)$	-1.20
$Al^{3+}(aq) + 3e^- \leftrightharpoons Al(s)$	-1.66
$Mg^{2+}(aq) + 2e^- \leftrightharpoons Mg(s)$	-2.38
$Na^+(aq) + e^- \leftrightharpoons Na(s)$	-2.71
$Ca^{2+}(aq) + 2e^- \leftrightharpoons Ca(s)$	-2.87
$K^+(aq) + e^- \leftrightharpoons K(s)$	-2.92

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Periodic Table

Atomic number — 11
Element symbol — Na
Mass number — 22.9

1 H 1.01																	2 He 4.00
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 40.00
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226	89 Ac (227)															

Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Actinides	90 Th 232.0	91 Pa (231)	92 U 238	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

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مركز القياس والتقويم التربوي
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MARKING GUIDE

GENERAL EDUCATION DIPLOMA

ROYAL GUARD OF OMAN TECHNICAL COLLEGE

SEMESTER TWO – SECOND SESSION

CHEMISTRY

2024 / 2025

Exam Specifications Second Semester for Chemistry Grade 12- First Session / Second Session(2024/2025)

Topic of the Units	Weighting %	Multiple Choice (20%)					Extended Response (80%)					Total Mark
		No. of Questions	Marks	Cognitive Levels			No. of Questions	Marks	Cognitive Levels			
				Knowing (30%)	Applying (50%)	Reasoning (20%)			Knowing (30%)	Applying (50%)	Reasoning (20%)	
Alcohols and carboxylic acids	**31 %**	**14**	4	1	2	١	**10**	18	5	9	4	**22**
Carbonyl Compounds	**15 %**		2	1	1	-		9	3	4	2	**11**
Electrochemistry	**54 %**		8	2	4	٢		29	9	15	5	**37**
Total	**100%**		**14**	**4**	**7**	**3**		**56**	**17**	**28**	**11**	**70**

General Education Diploma, Oman Royal Guard Technical College,
Semester Two, Second Session, Chemistry, 2024/2025.

Distribution of cognitive domains and marks.

QUESTION ONE: Multiple choice (14 marks)

Item	Mark	Unit	page	Cognitive domain	Output
1	1	Alcohols and Carboxylic acids	11	Knowing	4.1.b.iv
2	1	Alcohols and Carboxylic acids	22	Applying	4.2.b.iii
3	1	Alcohols and Carboxylic acids	10	Applying	4.1.b.iii
4	1	Alcohols and Carboxylic acids	22	Reasoning	4.2.b.iv
5	1	Carbonyl compounds	30	Knowing	5.1.a.i
6	1	Carbonyl compounds	35	Applying	5.1.c
7	1	Electrochemistry	56-65	Application	6.1.g
8	1	Electrochemistry	53-70	Reasoning	6.1.h.i
9	1	Electrochemistry	53-54	Knowledge	6.1.d,g
10	1	Electrochemistry	66-69	Application	6.1.i
11	1	Electrochemistry	73-75	Application	6.1.m
12	1	Electrochemistry	81	Knowing	6.2.a
13	1	Electrochemistry	85	Applying	6.2.c.i
14	1	Electrochemistry	78-80	Reasoning	6.2.c.ii

QUESTION TWO: Extended response (56 marks)

Item	Mark	Unit	Page	Cognitive domain	Output
15.a	1	Alcohols and Carboxylic acids	19-20	Knowing	4.2.a.ii
15.b.i	1	Alcohols and Carboxylic acids	19-20	Reasoning	4.2.a.ii
15.b.ii	1	Alcohols and Carboxylic acids	19-20	Reasoning	4.2.a.ii
15.c	1	Alcohols and Carboxylic acids	18	Knowing	4.2.a.i
15.d	3	Alcohols and Carboxylic acids	21-22	Applying	4.2.b.i 4.2.b.ii 4.2.b.iii
16.a.i	1	Alcohols and Carboxylic acids	7-8	Applying	4.1.a
16.a.ii	1	Alcohols and Carboxylic acids	7-8	Applying	4.1.a
16.b.i	1	Alcohols and Carboxylic acids	18-19	Applying	4.2.a.i
16.b.ii	1	Alcohols and Carboxylic acids	18-19	Applying	4.2.a.i
16.c	1	Alcohols and Carboxylic acids	18-19	Knowing	4.2.a.i
16.d	2	Alcohols and Carboxylic acids	12	Applying	4.1.c.i

17.a	1	Alcohols and Carboxylic acids	10	Knowing	4.1.c.ii
17.b	1	Alcohols and Carboxylic acids	10	Knowing	4.1.c.ii
17.c.i	1	Alcohols and Carboxylic acids	15	Reasoning	4.1.c.iii
17.c.ii	1	Alcohols and Carboxylic acids	13-14	Reasoning	4.1.c.ii
18.a	1	Carbonyl Compounds	35-36	Knowing	5.1.c
18.b	1	Carbonyl Compounds	36	Knowing	5.1.c
18.c	1	Carbonyl Compounds	36	Applying	5.1.c
18.d	1	Carbonyl Compounds	35-36	Reasoning	5.1.c
19.a.i	1	Carbonyl Compounds	30-34	Applying	5.1.c
19.a.ii	1	Carbonyl Compounds	30-34	Applying	5.1.c
19.b.i	1	Carbonyl Compounds	30-34	Applying	5.1.a.ii
19.b.ii	1	Carbonyl Compounds	30-34	Reasoning	5.1.a.ii
19.c	1	Carbonyl Compounds	32	Knowing	5.1.a.iii
20.a	1	Electrochemistry	54-61	Reasoning	6.1.h.i
20.b.i	1	Electrochemistry	55	Knowledge	6.1.a.ii
20.b.ii	1	Electrochemistry	51-60	Application	6.1.k
20.b.iii	1	Electrochemistry	66-69	Application	6.1.i
20.b.iv	2	Electrochemistry	56-65	Application	6.1.g
21.a	2	Electrochemistry	45-48	Knowledge	6.1.c
21.b	1	Electrochemistry	54-61	Application	6.1.h.i
21.c	1	Electrochemistry	54-61	Application	6.1.h.i
21.d	1	Electrochemistry	51-61	Application	6.1.K,f

21.e	1	Electrochemistry	66-69	Application	6.1.i
21.f	1	Electrochemistry	53-70	Reasoning	6.1.h.ii
٢٢a	1	Electrochemistry	55	Knowledge	6.1.a.ii
٢٢b	2	Electrochemistry	51-61	Knowledge	6.1.K,f
٢٢.c.i	1	Electrochemistry	45-61	Reasoning	6.1.h.i
22.c.ii	1	Electrochemistry	56-65	Application	6.1.g
٢٣.a	3	Electrochemistry	78	Knowing	6.2.a
٢٣.b	2	Electrochemistry	77-78	Applying	6.2.a
23.c	1	Electrochemistry	77-78	Reasoning	6.2.a
23.d	1	Electrochemistry	77-78	Reasoning	6.2.a
24.a	١	Electrochemistry	81-84	Applying	6.2.cii
24.b	1	Electrochemistry	81-84	Applying	6.2.cii
24.c	1	Electrochemistry	81-84	Applying	6.2.cii
24.d	1	Electrochemistry	81-84	Applying	6.2.ci

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Semester Two, Second Session, Chemistry, 2024/2025.

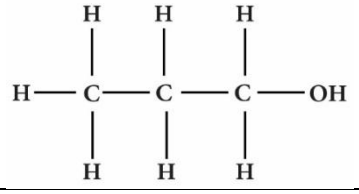
TOTAL MARKS: 70 **PAGES: 7**

Question One (14 Marks)

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

Item No.	Correct answer	
1	b	Ketones
2	d	$H_2O + CO_2$
3	a	Pentan-1-ol
4	c	-COOR
5	d	$K_2Cr_2O_7$
6	b	$CH_3CH_2CH_2CHO$
7	a	+1.56
8	c	Ni | From Fe to Ni
9	d	Hydrogen gas with a pressure of 100 Pa
10	b	Cu (cathode) | Gain
11	a	0.632
12	b	$2Cl^- \rightarrow Cl_2 + 2e^-$
13	c	510
14	a	31.78

Question Two (56 Marks)

<table>
<tr><th>Part</th><th>Section</th><th>The answer</th><th>The mark</th></tr>
<tr><td rowspan="6">15</td><td>a</td><td>Heat
Or
Acidic conditions.</td><td>1</td></tr>
<tr><td>b.i</td><td>X: $CH_3CH_2CH_2CN$</td><td>1</td></tr>
<tr><td>b.ii</td><td>Y: $CH_3CH_2CH_2COOCH_2CH_2CH_3$</td><td>1</td></tr>
<tr><td>C</td><td>Oxidation reaction.</td><td>1</td></tr>
<tr><td>d</td><td><table><tr><th>A</th><th>B</th></tr><tr><td>Potassium</td><td>H_2</td></tr><tr><td>KOH</td><td>H_2O</td></tr><tr><td>Na_2CO_3</td><td>$H_2O + CO_2$</td></tr></table>
<u>Note: one mark for each answer.</u></td><td>3</td></tr>
<tr><td rowspan="6">16</td><td>a.i</td><td></td><td>1</td></tr>
<tr><td>a.ii</td><td>Primary alcohol Or 1˚ alcohol.</td><td>1</td></tr>
<tr><td>b.i</td><td>CH_3CH_2CHO</td><td>1</td></tr>
<tr><td>b.ii</td><td>CH_3CH_2COOH</td><td>1</td></tr>
<tr><td>c</td><td>Acidified $KMnO_4$</td><td>1</td></tr>
<tr><td>d</td><td>$\boldsymbol{2C_3H_7OH + 9O_2 \rightarrow 6CO_2 + 8H_2O}$

Note:
- One mark for the <u>reactants</u> and one for the <u>products</u>.
- A balanced equation is not required.
- The student gets the mark if the reactants and products are indicated as below:
propan-1-ol <u>reacts with oxygen</u> to form <u>CO_2 and H_2O</u></td><td>2</td></tr>
</table>

Part	Section	The answer	The mark
17	a	Heat.	1
	b	Alcohols.	1
	c.i	Alkenes.	1
	c.ii	Halogenoalkanes.	1
18	a	- Distinguishing between aldehydes and ketones.	1
	b	- silver mirror - Or, mirror	1
	c	Ag^+	1

	d	- CH_3CH_2CHO
		- The explanation:
		  - The aldehyde reacts with a Tollen solution, while the ketone does not react.
		  - Or, $[Ag(NH_3)_2]^+$ ions are reduced to solid metallic silver, Ag
		  - Or, $Ag^+(aq)$
		  - $\rightarrow$ Ag(s)
		Or,
		Redox reaction
			1

Part	Section	The answer	The mark
١٩	a.i	$R - CHO$	1
	a.ii	$R - CO - R$	1
	b.i	$R - CH_2OH$	1
	b.ii	$\mathrm{R - CHOH - R}$	1
	c	HCN or ($NaCN + H_2SO_4$)	1
20	a	Cr/ Cr^{2+}	1
	b.i	The potential difference when two standard half- cells are connected under conditions (of 298K, 1 atm and all solutions at 1M)	1
	b.ii	$Cu^{2+}(aq) + Ni(s) \rightarrow Cu(s) + Ni^{2+}(aq)$	1
	b.iii	Cu **Or** copper	1
	b.iv	$E^{\theta}_{cell} = E^{\theta}\ reduction - E^{\theta}\ oxidation$ $\boldsymbol{E^{\theta}_{cell} = 0.34 - 0.25}$ $\boldsymbol{= +0.59\ V}$	1 1

Part	Section	The answer	The mark
21	a	- X salt bridge - M voltmeter	1 1
	b	Electrode A is Pb	1
	c	From Ni electrode to Sn electrode Or From half- cell Ni/Ni^{2+} to half-cell Sn/Sn^{2+}	1
	d	Electrode A is Zn	١
	e	$Pb^{2+}(aq) + 2e^{-} \rightleftharpoons Pb(s)$	١
	f	Yes, it will because $E^{\theta}_{cell} = E^{\theta}\ reduction - E^{\theta}\ oxidation$ $E^{\theta}_{cell} = -0.13 — 0.25$ $= +0.12\ V$ The value of the standard cell potential (E^{θ}_{cell}) is positive, which means it is feasible (Nickel metal (Ni) reduces Lead ions (Pb^{2+}) to Lead metal (Pb)). **Or**, because from standard electrode potentials Lead ions (Pb^{2+}) are a stronger oxidizing agent which means they can gain electrons more easily than Nickel ions (Ni^{2+}). **Or**, Nickel metal (Ni) is a stronger reducing agent than Lead metal (Pb), because it can lose electrons more easily than (Pb).	١

Part	Section	The answer	The mark
22	a	The voltage produced (in volts) of the standard half-cell connected to the standard hydrogen electrode under standard conditions (of 298K, 1atm and all solutions at 1M)	1
	b	$H_2(g) \rightarrow 2H^+(aq) + 2e^-$ $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$ NOTE: Each half-equation 1 mark	2
	c.i	S/ S^{2-} half-cell Because the(E^θ) value of the half-cell S/ S^{2-} is greater than the half-cell H/H^+, so S/ S^{2-} half-cell will be the positive pole. **Or**, A value of (E^θ) shows that reducing S is easier than reducing (H^+) ions (because its (E^θ) value is larger); Therefore the S will receive electrons.	1
	c.ii	$E^\theta_{cell} = E^\theta\ reduction - E^\theta\ oxidation$ $E^\theta_{cell} = 0.51 - (0.00)$ $= +\mathbf{0.51\ V}$ 1 mark only for the final result.	1

Part	Section	The answer	The mark
23	A	- The physical state. - The position in the redox series (electrode potential). - The concentration.	1 1 1
	b	$Mg^{2+} + 2e^- \rightarrow Mg$ $2Cl^- \rightarrow Cl_2 + 2e^-$ Note: balanced equations are not required.	1 1
	c	Mg(s) **Or** Magnesium.	1
	d	Chlorine gas **Or** Cl_2	1
24	a	For 0.100 kg (or 100 g) of iron: Number moles of Fe = $\frac{100\ g}{55.85\ g} = \mathbf{1.79\ mol}$ **Or 1.7905 mol**	1
	b	$Fe^{3+} + 3e^- \rightarrow Fe(s)$	1
	c	From the ionic half-equation, 3 moles of electrons are required to produce 1 mole of iron. Number moles of $e^- = \mathbf{1.79\ mol\ x\ 3 = 5.37\ mol\ e^-}$ **Or** $e^- = \mathbf{1.7905\ mol\ x\ 3 = 5.3715\ mol\ e^-}$	1
	d	Faraday's constant is approximately 96,500 C). The total amount of electricity needed $= 96500\ x\ 5.37 = \mathbf{518205\ C}$ **Or** $= 96500\ x\ 5.3715 = \mathbf{518350\ C}$	1

This is the end of the Marking Guide