

وزارة التربية والتعليم



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

امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)

الفصل الدراسي الأول - الدور الأول

للعام الدراسي ١٤٤٨/١٤٤٧ هـ - ٢٠٢٥ / ٢٠٢٦ 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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1) Which of the following statements describe the term conjugate acid?

(Shade in the bubble (⬭) next to the correct answer.)

⬭ A base that has lost a proton

⬭ An acid that has lost a proton

⬭ A base that has gained a proton

⬭ An acid that has gained a proton

[1]

2) Define the term ionic product of water K_w.

[1]

3) Calculate the K_a of benzoic acid, C_6H_5COOH (0.010 mol dm^{-3}), as shown in **Figure 3-1**. (Show all your work).



Figure 3-1

[2]

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4) Which of the following mixtures **cannot** be used as a buffer solution?

(Shade in the bubble (⬭) next to the correct answer.)

- ⬭ NH_3/NH_4Cl
- ⬭ $HNO_3/NaNO_3$
- ⬭ $H_2CO_3/KHCO_3$
- ⬭ C_6H_5COOH/C_6H_5COONa

[1]

5) Define the term a buffer solution.

_____

_____ [1]

6) Calculate the pH of the buffer solution that contains (0.25 mol dm^{-3} acetic acid, and 0.30 mol dm^{-3} sodium acetate, CH_3COONa).

(pK_a of CH_3COOH = 4.77)

(show all your work).

_____

_____

_____

_____

_____ [2]

7) If solubility = s, what is K_{sp} expression for Fe_2S_3 in terms of s?

(Shade in the bubble (⬭) next to the correct answer.)

- ⬭ $4\ s^3$
- ⬭ $6\ s^6$
- ⬭ $36\ s^4$
- ⬭ $108\ s^5$

[1]

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8) Predict whether $BaSO_4$ will precipitate in a solution that contains $[Ba^{2+}] = 0.050$ mol dm^{-3} and $[SO_4^{2-}] = 0.020$ mol dm^{-3}.

(K_{sp} of $BaSO_4 = 1.0 \times 10^{-10}$ mol^2 dm^{-6}) (show all your work)

[2]

9) **Figure 9-1** shows a saturated solution of lead (II) chloride ($PbCl_2$) which has a solubility of 1.6×10^{-2} mol dm^{-3}. Then a small amount of sodium chloride salt (NaCl) is added.

Calculate the solubility product K_{sp} of $PbCl_2$. include in your answer:

- The equilibrium equation.
- The equilibrium expression.
- Explain how the solubility of $PbCl_2$ would be affected in (step 2), according to Le Chatelier's principle.

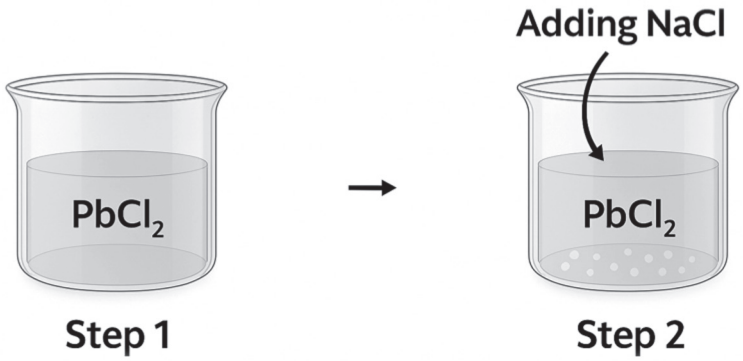


Figure 9-1

[5]

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10) Which term describes the difference in a standard electrode potential between two specified half cells?

(Shade in the bubble (⬭) next to the correct answer.)

⬭ Cell potential.

⬭ Electrode potential.

⬭ Standard cell potential.

⬭ Standard electrode potential.

[1]

11) **Figure 11-1** shows a Fe^{3+}/Fe half-cell connected to a standard hydrogen electrode

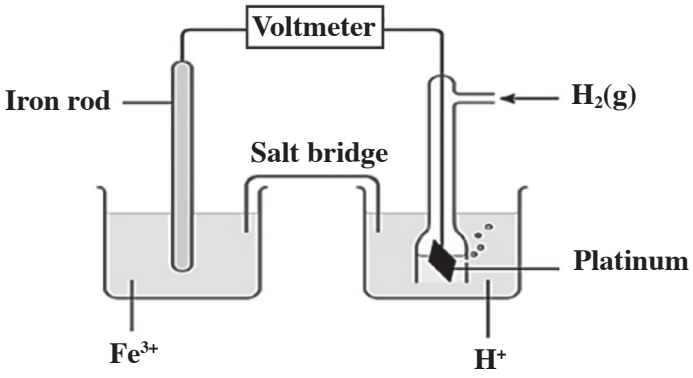


Figure 11-1

a. State the **three** standard conditions for the electrochemical cell in **Figure 11-1**

_____

_____

_____[3]

b. Construct the redox equation between the half- cells in **Figure 11-1**

_____

_____

_____[2]

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12) **Table 12-1** shows the standard electrode potentials of some half-cells.

half-cell	$E^{\ominus}$/(V)
$Cr^{3+}(aq) / Cr(s)$	– 0.74
$Mg^{2+}(aq) / Mg(s)$	– 2.38
$Ag^{+}(aq) / Ag(s)$	+ 0.80
$Ni^{2+}(aq) / Ni\ (s)$	– 0.25
$Cu^{2+}(aq) /Cu(s)$	+ 0.34

Table 12-1

a. Determine from the table:

(i) The easiest metal ion to reduce.

_____

(ii) The most reactive metal.

_____[2]

b. Deduce the feasibility if a piece of chromium metal is placed directly into a standard solution of Mg^{2+} ions.

(Shade in the bubble (⬭) next to the correct answer.)

⬭ Feasible ⬭ Not feasible

Explain your answer:

_____

_____

_____[1]

13) Which of the following will oxidise Pb^{2+} to Pb^{4+}?

(Shade in the bubble (⬭) next to the correct answer.)

⬭ Br_2 ⬭ F_2

⬭ Br^- ⬭ F^-

[1]

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14) **Table 14-1** shows the standard electrode of two reactions.

	Electrode reaction	E^{θ}/V
1	$VO_2^+(aq) + 2H^+(aq) + e^- \rightleftharpoons VO^{2+}(aq) + H_2O(l)$	+1.00
2	$PbO_2(s) + 4H^+(aq) + 2e^- \rightleftharpoons Pb^{2+}(aq) + 2H_2O(l)$	+1.47

Table 14-1

For reaction 1:

a. What is the effect on the value of E^{θ} if $[H^+]$ is increased and the other species are kept at the same concentration?

_____[1]

For reaction 2:

b. Why the value of E^{θ} decreases when $[Pb^{2+}]$ increases and the other species are kept at the same concentration?

_____[1]

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15) **Figure 15-1** shows an electrochemical cell under standard conditions.

Calculate the value of the electrode potential of the **cathode** electrode if the concentration of the ions changes to **0.2 mol dm^{-3}**. Include in your answer:

- The direction of the flow of electrons in the external circuit.
- The overall equation of the cell.
- The value of the standard cell potential E^{θ}_{cell}.

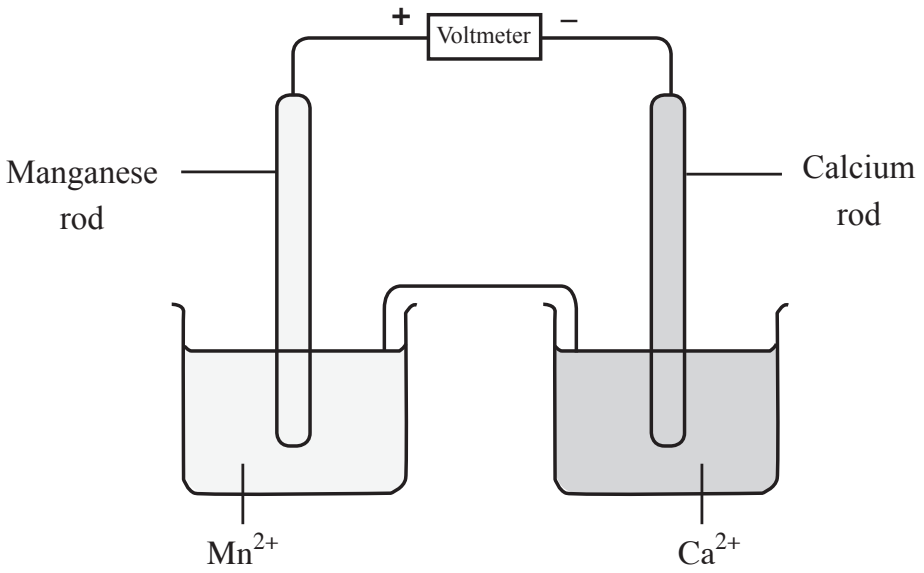


Figure 15-1

[6]

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16) **Figure 16-1** shows an electrolytic cell used to electrolyse an aqueous solution of potassium sulfate, K_2SO_4.

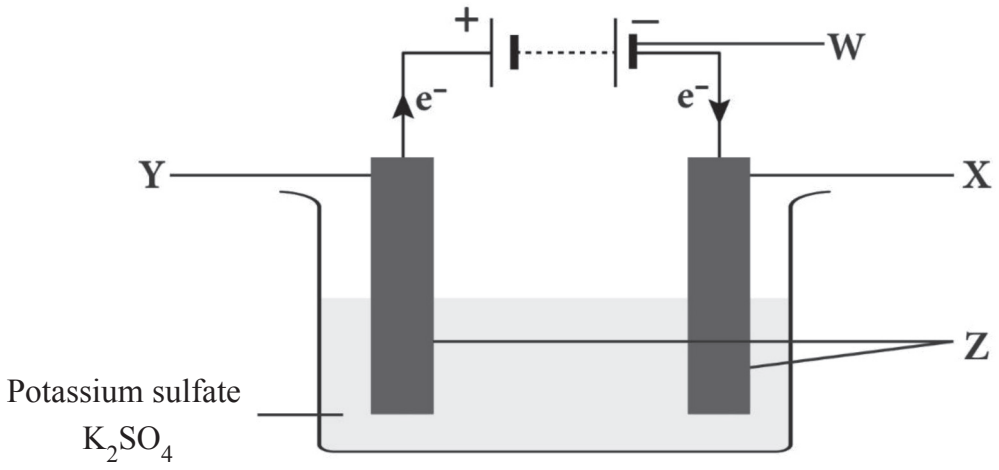


Figure 16-1

a. Which symbol indicates.

The anode: _____

The cathode: _____ [2]

b. Write the half-equation for the reaction occurring at the anode.

_____[1]

17) Which substance is **formed** at the negative electrode when solution of sodium sulfate, Na_2SO_4 is electrolysed using graphite electrodes?

(Shade in the bubble (⬭) next to the correct answer.)

⬭ $Na^+(aq)$ ⬭ $H^+(aq)$

⬭ $H_2(g)$ ⬭ $O_2(g)$

[1]

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18) Complete **Table 18-1**:

Electrolytes	Substance formed at cathode electrode	Substance formed at anode electrode
Concentrated aqueous ($CaCl_2$)		_____
Molten (Ag_2O)	_____	
Diluted aqueous (KOH)		_____

Table 18-1

[3]

19) What is the mass of aluminum (Al), deposited during electrolysis when a current of (2.4 A) flows through an aqueous solution of aluminum nitrate, $Al(NO_3)_3$ for three minutes.

(F = 96500 C/mol).

(Shade in the bubble (⬭) next to the correct answer.)

⬭ 0.014 g ⬭ 0.027 g

⬭ 0.040 g ⬭ 0.072 g

[1]

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20) The incomplete Born–Haber cycle for iron(II) iodide, FeI_2 is shown in **Figure 20-1**.

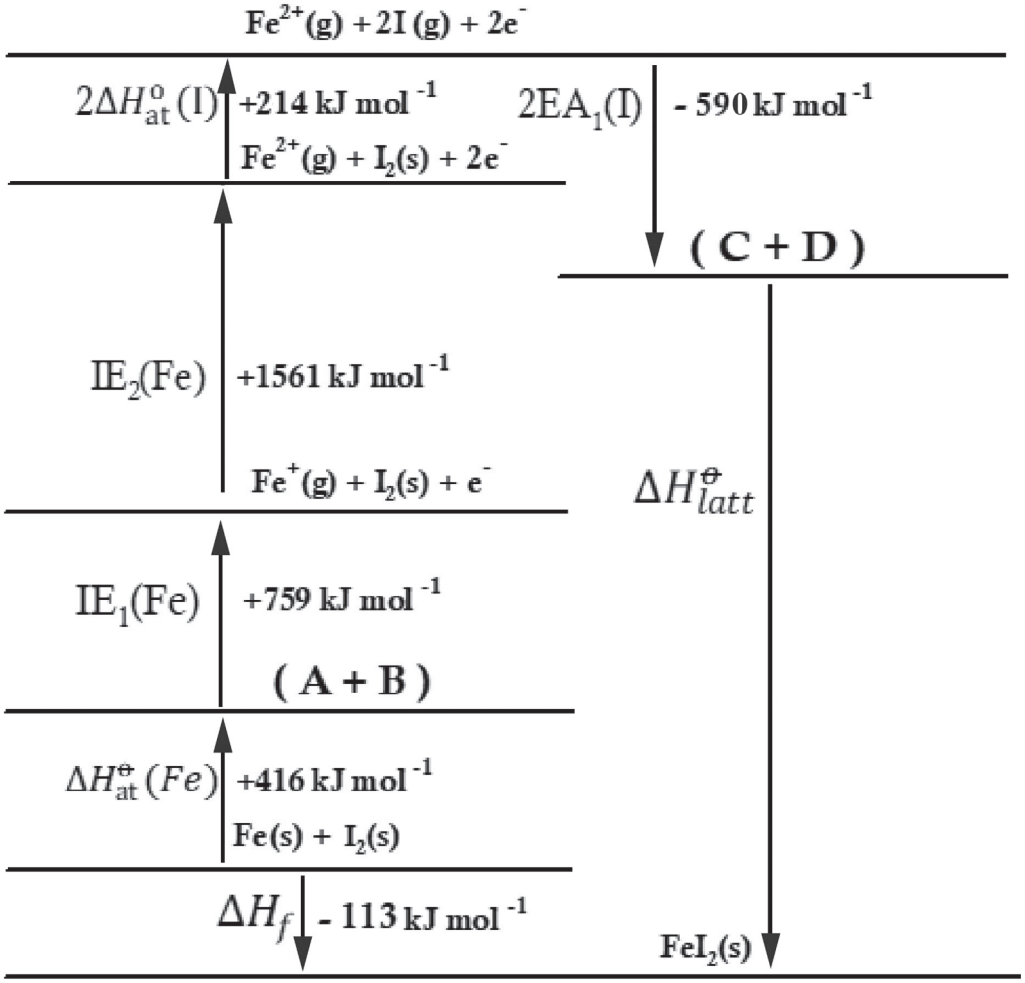


Figure 20-1

a. Identify the species (**A** + **B**) and (**C** + **D**) in the cycle, including the **physical state**.

(**A** + **B**): _____

(**C** + **D**): _____ [2]

b. Calculate the lattice energy, $\Delta H^{\ominus}_{latt}$ for iron (II) iodide, FeI_2.

_____

_____

_____

_____

_____ [2]

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Do not write in this space

21) The enthalpy of hydration, $\Delta H^{\ominus}_{hyd}$ for calcium, Ca^{2+} and barium, Ba^{2+} ions are:

Ion	$\Delta H^{\ominus}_{hyd}$ / kJ mol^{-1}
Ca^{2+}	– 1562
Ba^{2+}	– 1273

What is the expected $\Delta H^{\ominus}_{hyd}$ for a magnesium ion, Mg^{2+} in kJ mol^{-1}?

(Shade in the bubble (◯) next to the correct answer.)

◯ – 920 ◯ – 1150

◯ – 1414 ◯ – 1890

[1]

22) Write the equation in each row to represent each type of energy change in **Table 22-1**.

Energy change	Equation
$\Delta H^{\ominus}_{sol}$ of MgI_2	_____
$\Delta H^{\ominus}_{hyd}$ of Mg^{2+}	_____

Table 22-1

[2]

23) Define the enthalpy change of solution, $\Delta H^{\ominus}_{sol}$.

_____

_____

_____ [1]

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24) Which enthalpy change, $\Delta H^{\ominus}$ given below is endothermic?

(Shade in the bubble (○) next to the correct answer.)

○ $F(g) + e^- \longrightarrow F^-(g)$ ○ $Cl(g) + e^- \longrightarrow Cl^-(g)$

○ $O(g) + e^- \longrightarrow O^-(g)$ ○ $S^-(g) + e^- \longrightarrow S^{2-}(g)$ [1]

25) Calculate the enthalpy change of hydration, $\Delta H^{\ominus}_{hyd}$ for SO_4^{2-} ion in kJ mol^{-1}
Use the data in **Table 25-1**.

Enthalpy change	Value/ kJ mol^{-1}
Lattice energy, $\Delta H^{\ominus}_{latt}$ of K_2SO_4	– 1764
Enthalpy change of solution, $\Delta H^{\ominus}_{sol}$ of K_2SO_4	+24
Enthalpy change of hydration, $\Delta H^{\ominus}_{hyd}$ of K^+	– 320

Table 25-1

_____

_____

_____ [2]

26) **Figure 26-1** shows the first electron affinity of some elements.

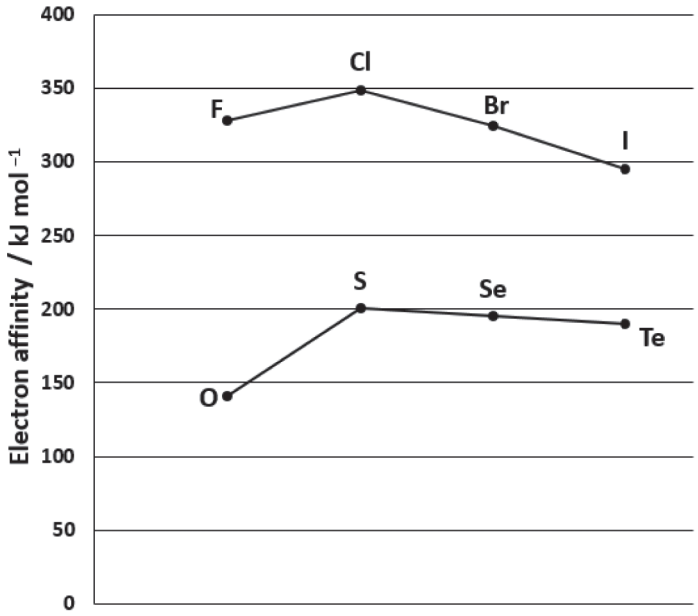


Figure 26-1

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a. Why is the first electron affinity of chlorine more exothermic than sulfur?

_____

_____ [1]

b. Explain the trend in the first electron affinity from chlorine to iodine.

_____

_____

_____ [1]

27) Which of the following options is the **correct** order according to the decreasing of exothermic lattice energy?

(Shade in the bubble (⬭) next to the correct answer.)

⬭ MgO > NaF > RbF ⬭ RbF > NaF > MgO

⬭ MgO > RbF > NaF ⬭ NaF > RbF > MgO [1]

28) **Figure 28-1** shows the formation of *N*-propylphenylamide, starting from nitrile.

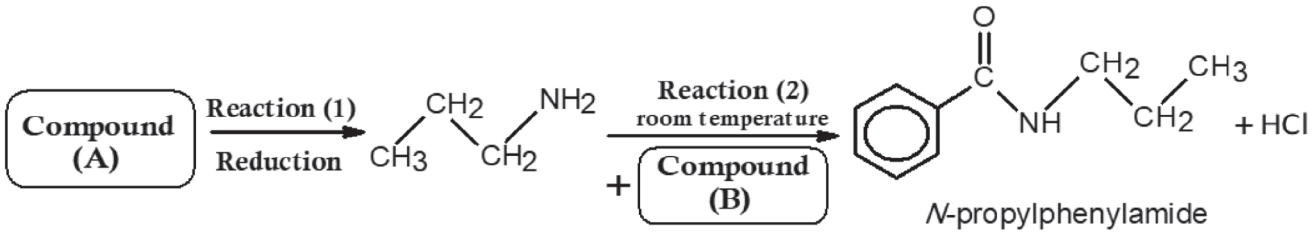


Figure 28-1

a. What is the reagent used in Reaction (1)?

_____ [1]

b. Draw the **structural** formula of:

Compound **(A)** Compound **(B)** [2]

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29) Which of the following reactions produce a secondary amine?

(Shade in the bubble (○) next to the correct answer.)

- ○ Reduction of CH_3CN
- ○ Reduction of CH_3CONH_2
- ○ Reaction of CH_3Br with CH_3NH_2
- ○ Reaction of CH_3Br with excess NH_3

[1]

30) Four nitrogen compounds are shown in **Table 30-1**.

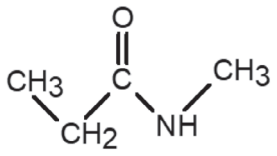
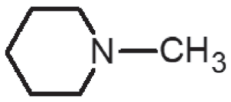
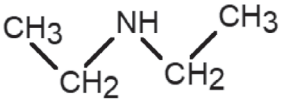
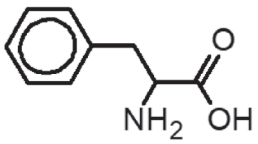
A	B	C	D
			

Table 30-1

a. Classify the **amine (B)**.

_____ [1]

b. What is the formula of the compound produced by the reduction of compound **(A)**?

_____ [1]

c. Explain, compound **(C)** is a stronger base than ammonia.

_____

_____ [1]

31) Which of the following compounds is the **least basic**?

(Shade in the bubble (○) next to the correct answer.)

- ○ CH_3NH_2
- ○ CH_3CONH_2
- ○ $(CH_3)_2NH$
- ○ $(CH_3CH_2)_2NH$

[1]

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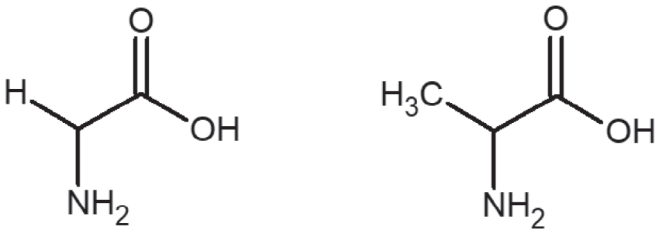
32) Draw the structural formula of each compound in **Table 32-1**.

Name	Structural formula
dibutylamine	
propanamide	

Table 32-1

[2]

33) The amino acids (glycine) and (alanine) are shown in **Figure 33-1**.



Glycine, Gly Alanine, Ala

Figure 33- 1

a. Draw the structure of alanine at pH = 6.0 and pH = 10.0

(The isoelectric point of alanine is 6.0)

at pH = 6.0 at pH = 10.0

[2]

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b. Draw the structure of the tripeptide **(Gly – Ala – Gly)**.

(The peptide bonds formed should be **labeled**).

[2]

[End of the Examination]

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Standard electrde potentals

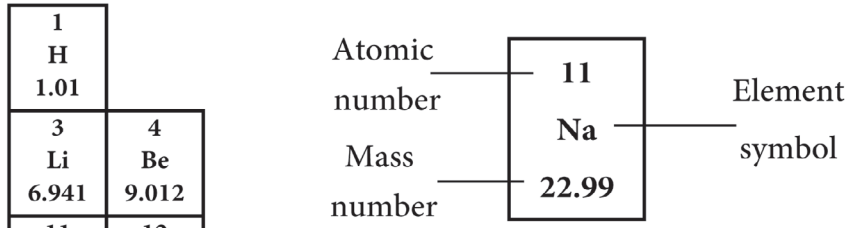
Electrd reaction	E^{θ}/V
$F_2(g)+2e^- \rightleftharpoons 2F^-(aq)$	+2.87
$S_2O_8^{2-}(aq)+2e^- \rightleftharpoons 2SO_4^{2-}(aq)$	+2.01
$H_2O_2(l)+2H^+(aq)+2e^- \rightleftharpoons 2H_2O(l)$	+1.77
$Pb^{4+}(aq)+2e^- \rightleftharpoons Pb^{2+}(aq)$	+1.69
$MnO_4^-(aq)+8H^+(aq)+5e^- \rightleftharpoons Mn^{2+}(aq)+4H_2O(l)$	+1.52
$PbO_2(s)+4H^+(aq)+2e^- \rightleftharpoons Pb^{2+}(aq)+2H_2O(l)$	+1.47
$Cl_2(g)+2e^- \rightleftharpoons 2Cl^-(aq)$	+1.36
$Cr_2O_7^{2-}(aq)+14H^+(aq)+6e^- \rightleftharpoons 2Cr^{3+}(aq)+7H_2O(l)$	+1.33
$O_2(g)+4H^+(aq)+4e^- \rightleftharpoons 2H_2O(l)$	+1.23
$Br_2(l)+2e^- \rightleftharpoons 2Br^-(aq)$	+1.07
$VO_2^+(aq)+2H^+(aq)+e^- \rightleftharpoons VO^{2+}(aq)+H_2O(l)$	+1.00
$VO_3^-(aq)+4H^+(aq)+e^- \rightleftharpoons VO^{2+}(aq)+2H_2O(l)$	+1.00
$ClO^-(aq)+H_2O(l)+2e^- \rightleftharpoons Cl^-(aq)+2OH^-(aq)$	+0.89
$NO_3^-(aq)+10H^+(aq)+8e^- \rightleftharpoons NH_4^+(aq)+3H_2O(l)$	+0.87
$NO_3^-(aq)+2H^+(aq)+e^- \rightleftharpoons NO_2(g)+H_2O(l)$	+0.81
$Ag^+(aq)+e^- \rightleftharpoons Ag(s)$	+0.80
$Fe^{3+}(aq)+e^- \rightleftharpoons Fe^{2+}(aq)$	+0.77
$I_2(s)+2e^- \rightleftharpoons 2I^-(aq)$	+0.54
$Cu^+(aq)+e^- \rightleftharpoons Cu(s)$	+0.52
$O_2(g)+2H_2O(l)+4e^- \rightleftharpoons 4OH^-(aq)$	+0.40
$Cu^{2+}(aq)+2e^- \rightleftharpoons Cu(s)$	+0.34
$VO^{2+}(aq)+2H^+(aq)+e^- \rightleftharpoons V^{3+}(aq)+H_2O(l)$	+0.34

Electrde reaction	E^{θ}/V
$SO_4^{2-}(aq)+4H^+(aq)+2e^- \rightleftharpoons SO_2(g)+2H_2O(l)$	+0.17
$Cu^{2+}(aq)+e^- \rightleftharpoons Cu^+(aq)$	+0.15
$Sn^{4+}(aq)+2e^- \rightleftharpoons Sn^{2+}(aq)$	+0.15
$S_4O_6^{2-}(aq)+2e^- \rightleftharpoons 2S_2O_3^{2-}(aq)$	+0.09
$2H^+(aq)+2e^- \rightleftharpoons H_2(g)$	0.00
$Fe^{3+}(aq)+3e^- \rightleftharpoons Fe(s)$	−0.04
$Pb^{2+}(aq)+2e^- \rightleftharpoons Pb(s)$	−0.13
$Sn^{2+}(aq)+2e^- \rightleftharpoons Sn(s)$	−0.14
$Ni^{2+}(aq)+2e^- \rightleftharpoons Ni(s)$	−0.25
$V^{3+}(aq)+e^- \rightleftharpoons V^{2+}(aq)$	−0.26
$Co^{2+}(aq)+2e^- \rightleftharpoons Co(s)$	−0.28
$Fe^{2+}(aq)+2e^- \rightleftharpoons Fe(s)$	−0.44
$Cr^{3+}(aq)+3e^- \rightleftharpoons Cr(s)$	−0.74
$Zn^{2+}(aq)+2e^- \rightleftharpoons Zn(s)$	−0.76
$2H_2O(l)+2e^- \rightleftharpoons H_2(g)+2OH^-(aq)$	−0.83
$Cr^{2+}(aq)+2e^- \rightleftharpoons Cr(s)$	−0.91
$Mn^{2+}(aq)+2e^- \rightleftharpoons Mn(s)$	−1.18
$V^{2+}(aq)+2e^- \rightleftharpoons V(s)$	−1.20
$Mg^{2+}(aq)+2e^- \rightleftharpoons Mg(s)$	−2.38
$Na^+(aq)+e^- \rightleftharpoons Na(s)$	−2.71
$Ca^{2+}(aq)+2e^- \rightleftharpoons Ca(s)$	−2.87
$K^+(aq)+e^- \rightleftharpoons K(s)$	−2.92

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Periodic Table



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)

MARKING GUIDE OF GENERAL EDUCATION DIPLOMA
BILINGUAL PRIVATE SCHOOLS
FIRST SESSION – SEMESTER ONE
CHEMISTRY
2025 / 2026

وزارة التربية والتعليم

Note: Marking scheme in (9) sheets. Subject: Chemistry Total marks: 70

Item	Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
					Cambr	Hodd		
1	A base that has gained a proton	1		Quantitative Equilibria	441	367	1.1.a	AO1
2	is the equilibrium constant for the ionisation of water. Or $K_w = [H^+][OH^-]$	1	is equal to the concentration of hydrogen ions (H^+) multiplied by the concentration of hydroxide ions (OH^-) in a solution.		442	368	1.1.c	AO1
3	$[H^+]=10^{-pH}=10^{-3.1}=\underline{7.94\times10^{-4}}$ mol dm^{-3} $K_a = \frac{[H^+]^2}{[C_6H_5COOH]}$	1			447	396	1.1.c	AO2

Item	Answer	Mark	Additional Information	Unit	Page Cambr	Page Hodd	Learning Outcome	Assessment Objective
	$K_a = \frac{(7.94 \times 10^{-4})^2}{(0.01)}$ K_a=<u>6.3×10^{-5} mol dm^{-3}</u>	1						
4	$HNO_3/NaNO_3$	1			449		1.1. f	AO2
5	a solution that minimises changes in pH when moderate amounts of acid or base are added. **Or** a mixture of a weak acid and its conjugate base or a weak base and its conjugate acid.	1	Accept reduce or resist		448	371	1.1. e	AO1
6	pH of the Buffer: $pH = pK_a + \log(\frac{[A^-]}{[HA]})$ $pH = 4.77 + \log(\frac{0.3}{0.25})$ pH=<u>4.85</u> <u>Or</u>	1 1			450		1.1.i	AO2

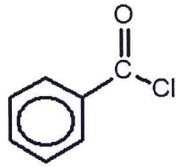
Item	Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
					Cambr	Hodd		
	$[H^+] = \frac{K_a[CH_3COOH]}{[CH_3COONa]}$ $= \frac{(1.698\times10^{-5})\times(0.25)}{(0.30)}$ $= 1.445\times10^{-5}$ pH= -log1.415×10^{-5} = 4.85	1 1						
7	$108s^5$	1			454		1.1.m	AO2
8	$[Ba^{2+}][SO_4^{2-}] = 0.050 \times 0.020$ $[Ba^{2+}][SO_4^{2-}] = 1.0 \times 10^{-3}\ mol^2\ dm^{-6}$ $[Ba^{2+}][SO_4^{2-}] > K_{sp}$ → Precipitate will form	1 1			456	375	1.1.o	AO2
9	$PbCl_2(s) \rightleftharpoons Pb^{2+}(aq) + 2Cl^-(aq)$ $[Pb^{2+}] = s = 1.6 \times 10^{-2}$ mol dm^{-3} $[Cl^-] = 2s = 3.2 \times 10^{-2}$ mol dm^{-3} $K_{sp} = [Pb^{2+}][Cl^-]^2$ $K_{sp} = (1.6 \times 10^{-2}) \times (3.2 \times 10^{-2})^2$	1 1 1	correct balanced equation with physical states.		454		1.1.m 1.1.n	AO2

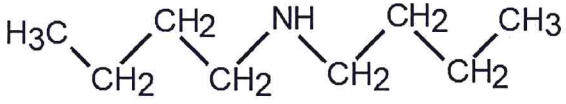
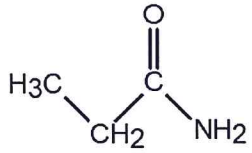
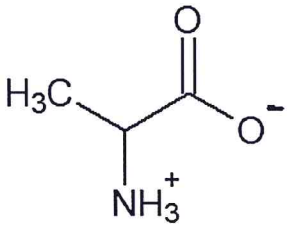
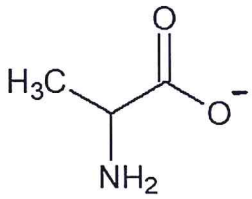
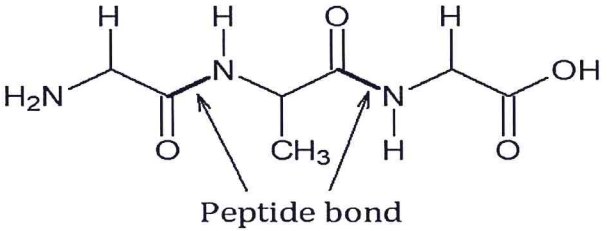
Item		Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
						Cambr	Hodd		
		$K_{sp} = (1.6 \times 10^{-2}) \times (1.024 \times 10^{-3})$ $K_{sp} = 1.6 \times 10^{-5}$ mol^3 dm^{-9} **Reducing** the solubility of $PbCl_2$ Or This shifts the equilibrium **left.**	1 1	(units are not required).					
10		Standard cell potential	1		**Electrochemistry**	417	443	2.1. bii	AO1
11	**a**	298 K **Or** 25 C^o 1 atm **Or** 101 Kpa 1.00 mol dm^{-3}	1 1 1			411	442	2.1 e	AO1
	b	$6H^+(aq) + 2Fe(s) \rightarrow 3H_2(g) + 2Fe^{3+}(aq)$	1+1	1 mark for left side 1mark for right side		414	444	2.1. j	AO2
12	**a**	- Ag^+ - Mg	1 1			412	441	2.1. i	AO2
	b	Not feasible $E^{\ominus}_{cell} = E^{\ominus}$ (cathode) - $E^{\ominus}$ (Anode) $= -2.38 - (-0.74) = -1.64$ V when $E^{\ominus}_{cell}$ is negative, the reaction will be not feasible or Mg^{+2} is a weak oxidizing agent or Cr^{+3} stronger oxidizing agent .	1	The mark for the correct choice and explanation.		419	446	2.1. h	AO2

Item		Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
						Cambr	Hodd		
13		F_2	1			420	444	2.1.i	AO2
14	a	Increase **Or** more positive **Or** less negative	1			424	446	2.1. k	AO1
	b	Because the equilibrium position shifts to the left.	1			424	446	2.1. k	AO1
15		**The direction of the flow of electrons in the external circuit.** Ca^{2+}/Ca half -cell to Mn^{2+}/Mn half -cell **The overall equation of the cell.** $Mn^{2+}(aq) + Ca(s) \rightarrow Mn(s) + Ca^{2+}(aq)$ **The value of the standard cell potential.** $Mn^{+2}(aq) + 2e^- \rightleftharpoons Mn(s) \quad E^o = -1.18$ $Ca^{+2}(aq) + 2e^- \rightleftharpoons Ca(s) \quad E^o = -2.87$ E^o_{cell} = (cathode) _ (Anode) = -1.18 - (-2.87) = 1.69 V $E = E^0 + \frac{0.059}{z} \log_{10} \frac{[\text{oxidised species}]}{[\text{reduced species}]}$ $= -1.18 + \frac{0.059}{2} \log_{10} \frac{[Mn^{+2}]}{[Mn]}$ $= -1.18 + \frac{0.059}{2} \log_{10} \frac{0.2}{1}$ = -1.20 V	1 1 1 1 1 1	Accept the drawing on the Figure All of the equation must be correct 1mark for z =2		413 426	441, 442, 449	2.1. l 2.1. g	AO2

Item		Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
						Cambr	Hodd		
16	a	The anode: **Y** The cathode: **X**	1 1			407	452	2.2. a	AO1
	b	$4OH^-(aq) \rightarrow 2H_2O(l) + O_2(g) + 4e^-$	1	All the equation must be correct		407	452	2.2bi	AO2
17		$H_2(g)$	1			429	452	2.2bi	AO1
18		<table><tr><th>Electrolytes</th><th>Substance formed at cathode electrode</th><th>Substance formed at anode electrode</th></tr><tr><td>Concentrated aqueous ($CaCl_2$)</td><td></td><td>Cl_2</td></tr><tr><td>Molten (Ag_2O)</td><td>Ag</td><td></td></tr><tr><td>Diluted aqueous(KOH)</td><td></td><td>O_2</td></tr></table>	1 1 1			427 428	452 453	2.2 b i 2.2 b iii	AO2
19		0.040 g	1			409	451	2.2 d ii	AO2
20	a	A + B: $Fe(g) + I_2(s)$ C + D: $Fe^{2+}(g) + 2I^-(g)$	1 1		Lattice energy	385	329	3.1.e	AO2
	b	$\Delta H^{\ominus}_{latt} = \Delta H^{\ominus}_f[FeI_2] - (\Delta H^{\ominus}_{at}[Fe] + 2\Delta H^{\ominus}_{at}[I] + IE_1[Fe] + IE_2[Fe] + 2EA_1[I])$ $= -113 - (+416 + 214 + 759 + 1561 - 590)$ $= -2473\ kJ\ mol^{-1}$	1 1					3.1.f	AO2
21		– 1890	1			393	333	3.2.d	AO2

Item	Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
					Cambr	Hodd		
22	$MgI_2(s) + aq \rightarrow MgI_2(aq)$ Or $MgI_2(s) + aq \rightarrow Mg^{2+}(aq) + 2I^-(aq)$ $Mg^{2+}(g) + aq \rightarrow Mg^{2+}(aq)$	1 1			391	333	3.2.a	AO2
23	The Standard enthalpy change of solution, ΔH^{θ}_{sol}: The energy absorbed or released when 1 mole of an ionic solid dissolves in sufficient water to form a very dilute solution under standard conditions.	1					3.2.a	AO1
24	$S^-(g) + e^- \rightarrow S^{2-}(g)$	1		Lattice energy	384	330	3.1.b 3.1.e	AO1
25	$\Delta H^{\theta}_{hyd}[SO_4^{2-}] = \Delta H^{\theta}_{latt}[k_2SO_4] + \Delta H^{\theta}_{sol}[k_2SO_4] - 2\Delta H^{\theta}_{hyd}[K^+]$ $= -1764 + 24 - (2 \times -320)$ $= -1100$ kJ mol^{-1}	1 1			394	334	3.2.c	AO2
26 a	Chlorine, with a greater nuclear charge than sulfur, will tend to attract an electron more readily. This means that more energy is released when a chlorine atom gains an electron.	1			384	330	3.1.d	AO2
26 b	The further away the outer shell electrons are from the positive nuclear charge, the less attractive the force is between the nucleus and the outer shell electrons. Since the number of electron shells (and the atomic radius) increases down the group, the electron affinity decreases going from chlorine to bromine to iodine.	1					3.1.d	AO1

Item		Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
						Cambr	Hodd		
27		$MgO > NaF > RbF$	1			388	331	3.1.g	AO2
28	a	$LiAlH_4$ or H_2 /Ni	1		Nitrogen compounds	450	450	4.1.c.iv	AO2
	b	Compound **(A)** CH_3CH_2CN Compound **(B)**  Or C_6H_5COCl	1 1					4.1.c.iv 4.2.b.ii	AO2
29		Reaction of CH_3Br with CH_3NH_2	1					4.1.c.ii	AO1
30	a	Tertiary	1			572	451	4.1.a	AO2
	b	$CH_3CH_2CH_2NHCH_3$	1					4.1.c.iii	AO1
	c	Compound **(C)** is a stronger base than ammonia because the ethyl groups are electron-donating, which makes the lone pair of electrons on N atom more readily available to bond with an H^+ ion than it is in ammonia.	1					4.1.e	AO2
31		CH_3CONH_2	1					4.2.d	AO2

32		 	1 1			572	451	4.1.b 4.2.a	AO1
33	**a**	 At pH = 6.0  at pH = 10.0	1+1	1 mark for each one.		576	461	4.3.b	AO2
	b	 Peptide bond	1+1	1 mark for structure, 1 mark for the peptide bonds.				4.3.c	AO2

This is the end of the Marking Guide

وزارة التعليم

امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)

الفصل الدراسي الأول - الدور الثاني

للعام الدراسي ١٤٤٨/١٤٤٧ هـ - ٢٠٢٥ / ٢٠٢٦ م

تنبيه:
- المادة: الكيمياء.
- الأسئلة في (١٧) 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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1) What is the conjugate base of H_3PO_4?

(Shade in the bubble (⬭) next to the correct answer.)

⬭ OH^- ⬭ PO_4^{3-}

⬭ $H_2PO_4^-$ ⬭ HPO_4^{2-} [1]

2) Identify the acid and its conjugate base pair for the **forward** direction of the following reaction:

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

_____ [1]

3) Calculate the pH of butanoic acid, C_3H_7COOH 0.10 mol dm^{-3}.

(K_a of C_3H_7COOH = 1.3 × 10^{-5} mol dm^{-3})

(Show all your work)

_____

_____

_____

_____ [2]

4) What is the pH of a buffer solution that has [A^-] = [HA]?

(Shade in the bubble (⬭) next to the correct answer.)

⬭ $pH = K_w$ ⬭ $pH = [H^+]$

⬭ $pH = K_a$ ⬭ $pH = pK_a$ [1]

5) Define the term acid dissociation constant (K_a).

_____

_____

_____ [1]

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6) Write for $Fe(OH)_2$:

Dissociation equation:

_____ [1]

Solubility products expression (K_{sp}):

_____ [1]

7) Which of the following mixtures acts as a buffer system?

(Shade in the bubble (⬭) next to the correct answer.)

- ⬭ HCl / $NaCl$
- ⬭ NH_3 / NH_4Cl
- ⬭ HNO_3/ $NaNO_3$
- ⬭ H_2SO_4 / $NaHSO_4$ [1]

8) Predict by calculation whether $CaCO_3$ will **precipitate** in a solution that contains $[Ca^{2+}] = 2.0 \times 10^{-3}$ mol dm^{-3} and $[CO_3^{2-}] = 1.5 \times 10^{-3}$ mol dm^{-3}.

(K_{sp} of $CaCO_3$ = 5.0 × 10^{-9} mol^2 dm^{-6} at 25°C)

_____

_____

_____

_____ [2]

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9) **Calculate the pH change** after adding 0.010 mol of HCl to 1.00 dm³ buffer solution containing 0.20 mol dm^{-3} benzoic acid, C_6H_5COOH and 0.30 mol dm^{-3} sodium benzoate, C_6H_5COONa.

(K_a of benzoic acid = 6.3×10^{-5} mol dm^{-3}).

Include in your answer the:

- pH of buffer solution before adding the acid.
- pH after adding the acid.

[5]

10) Which term describes the type of cell used as reference electrodes?

(Shade in the bubble (⬭) next to the correct answer.)

⬭ Electrode potential.

⬭ Standard cell potential.

⬭ Standard electrode potential.

⬭ Standard hydrogen electrode. [1]

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11) **Figure 11.1** shows an electrochemical cell made by connecting $Cu^{2+}(aq)$ /Cu(s) half-cell to $Mg^{2+}(aq)$ /Mg(s) half-cell.

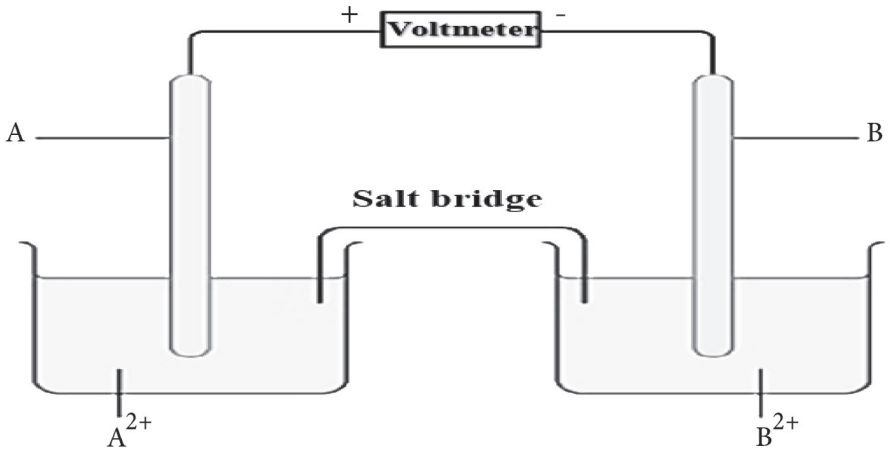


Figure 11.1

a. State **two** standard conditions to make each half-cell.

_____

_____ [2]

b. Determine **the material** of each electrode:

Anode:_____

Cathode:_____ [2]

c. Which of the following is **correct** about **Figure 11.1**?

(Shade in the bubble (⬭) next to the **correct** answer.)

⬭ Rod **A** is reduced.

⬭ The reading of the voltmeter is 0.49 V.

⬭ Metal **B** will lose electrons to the $A^{2+}(aq)$ /A(s) half-cell.

⬭ The electrons flow from $A^{2+}(aq)$ /A(s) half -cell to $B^{2+}(aq)$ /B(s) half-cell. [1]

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12) **Table 12.1** shows some electrodes' reactions under standard conditions.

	Electrode reaction	E^{θ}/ V
1	$Br_2(aq) + 2e^- \rightleftharpoons 2Br^-(aq)$	+1.07
2	$Mn^{2+}(aq) + 2e^- \rightleftharpoons Mn(s)$	-1.18
3	$V^{2+}(aq) + 2e^- \rightleftharpoons V(s)$	-1.20
4	$Pb^{2+}(aq) + 2e^- \rightleftharpoons Pb\ (s)$	-0.13
5	$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$	+0.34

Table 12.1

a. State from **Table 12.1**:

- The strongest oxidising agent.

_____ [1]

- The strongest reducing agent.

_____ [1]

b. What is the value of E^{θ} cell of connecting $Cu^{2+}(aq)$ /Cu(s) half-cell to $Mn^{2+}(aq)$ /Mn(s) half-cell?

_____

_____ [1]

c. Deduce if bromine, Br_2 will oxidise lead, Pb to lead ion, Pb^{2+} by writing the redox **equation** and **calculating** $E^{\ominus}_{cell}$.

_____

_____

_____

_____ [3]

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13) **Figure 13.1** shows one type of an electrochemical cell.

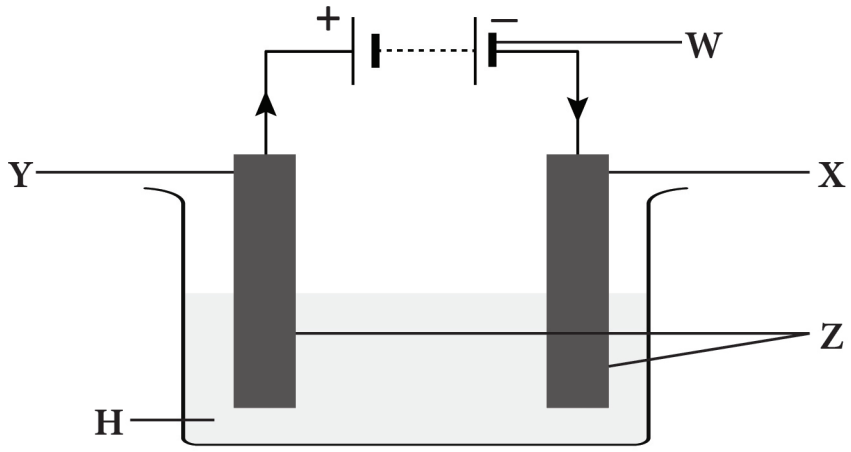


Figure 13.1

a. Identify the type of this cell.

_____ [1]

b. Which symbol represents the direct current power supply?

_____ [1]

c. Which symbol represents the anode?

_____ [1]

14) Which of the following terms is the **correct** relation between the Faraday constant, F, Avogadro's constant, L, and the electron charge e ?

(Shade in the bubble (⬭) next to the correct answer.)

⬭ $F = e/L$ ⬭ $F = 1/L.e$

⬭ $F = L.e$ ⬭ $F = L/e$ [1]

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Do not write in this space

15) **Calculate** the volume of gas produced at a cathode at r.t.p when a diluted aqueous solution of sulfuric acid, H_2SO_4 is electrolysed for 10 min using a current of 0.8 A.

(F = 96500 C mol^{-1}, 1mole of gas occupies 24.0 dm^3 at r.t.p)

Include in your answer:

- The equation for the anode.
- The equation for the cathode.

[6]

16) **Calculate** the time in **minutes** for the electrolysis when a constant electric current of (0.25A) passed through a cell containing molten potassium iodide, KI. The transferred charge during the electrolysis was 3600 C .

[3]

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17) What are the substances formed at the anode and cathode in the cell shown in **Figure 17.1**?

(Shade in the bubble (⬭) next to the correct answer.)

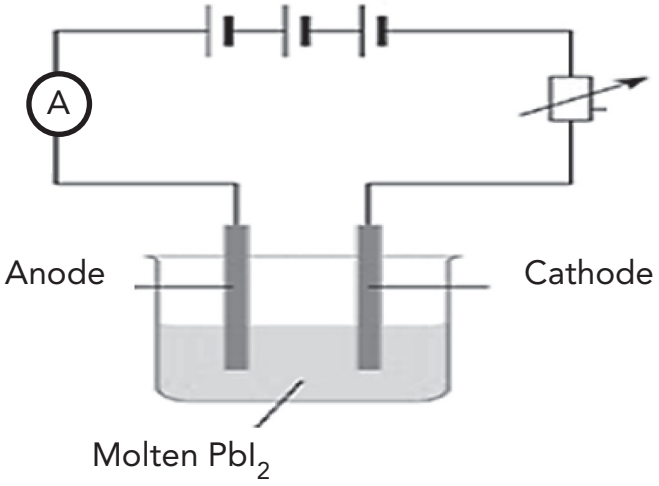


Figure 17.1

	Anode	Cathode
⬭	I^-	Pb
⬭	Pb	I^-
⬭	I_2	Pb
⬭	Pb	I_2

[1]

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18) **Figure 18.1** shows an incomplete Born–Haber cycle for lithium bromide, LiBr.

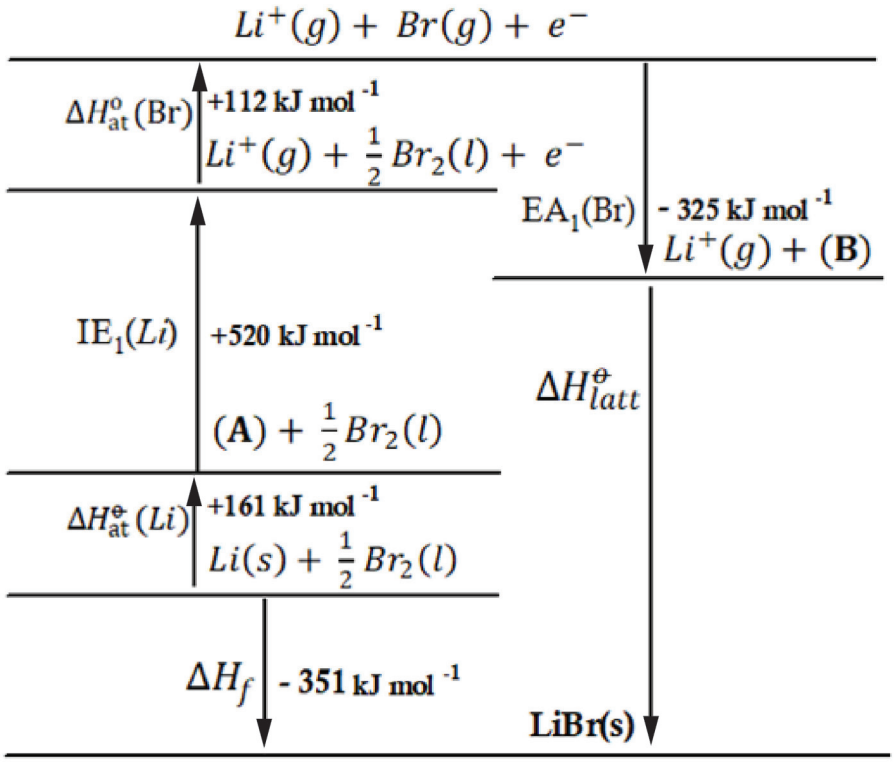


Figure 18.1

a. Identify the species (**A**) and (**B**) in the cycle, including the **physical state**.

(**A**): _____

(**B**): _____ [2]

b. Calculate the lattice energy, $\Delta H^{\ominus}_{latt}$ for lithium bromide, LiBr.

_____

_____

_____

_____

_____ [2]

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19) Which of the following options is **correct** about the value of the first and the second electron affinity of sulfur, S?

(Shade in the bubble (⬭) next to the correct answer.)

	EA_1[S] / kJ mol^{-1}	EA_2[S] / kJ mol^{-1}
⬭	– 620	– 156
⬭	+ 620	– 156
⬭	– 200	+640
⬭	+ 200	+640

[1]

20) Write the type of energy change in each row in **Table 20.1**.

Equation	Type of energy change
$Ba(s) \longrightarrow Ba(g)$	_____
$Ba(g) \longrightarrow Ba^+(g) + e^-$	_____

Table 20.1

[2]

21) Define the enthalpy change of lattice energy, $\Delta H^{\ominus}_{latt}$.

_____

_____ [1]

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Do not write in this space

22) Which of the following steps is exothermic in the Born–Haber cycle for lithium fluoride, LiF?

(Shade in the bubble (⬭) next to the correct answer.)

⬭ $Li(s) \longrightarrow Li(g)$

⬭ $Li(g) \longrightarrow Li^+(g) + e^-$

⬭ $\frac{1}{2} F_2(g) \longrightarrow F(g)$

⬭ $F(g) + e^- \longrightarrow F^-(g)$ [1]

23) Calculate the enthalpy change of hydration, ΔH^{θ}_{hyd} for the fluoride ion, F^- in kJ mol^{-1} by using the data in the **Table 23.1**.

Enthalpy change	Value/ kJ mol^{-1}
Lattice energy, $\Delta H^{\ominus}_{latt}$ of CaF_2	– 2630
Enthalpy change of solution, $\Delta H^{\ominus}_{sol}$ of CaF_2	+13
Enthalpy change of hydration, $\Delta H^{\ominus}_{hyd}$ of Ca^{2+}	– 1609

Table 23.1

[2]

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24) **Figure 24.1** shows the lattice energy, $\Delta H^{\ominus}_{latt}$ of some elements.

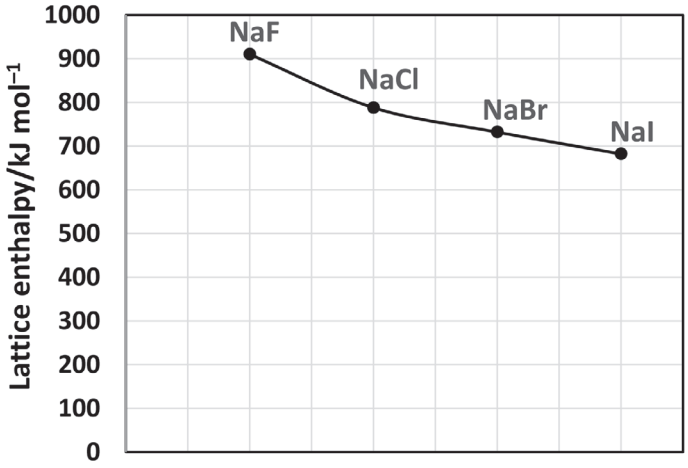


Figure 24.1

a. Write the equation of lattice energy, $\Delta H^{\ominus}_{latt}$ for NaBr.

_____

_____ [1]

b. Explain the trend in the lattice energy from NaF to NaI.

_____

_____

_____ [1]

25) Which of the following options is the correct order according to the decreasing of exothermic hydration energy?

(Shade in the bubble (⬭) next to the correct answer.)

⬭ $Mg^{2+} > Li^{+} > Na^{+}$

⬭ $Na^{+} > Li^{+} > Mg^{2+}$

⬭ $Mg^{2+} > Na^{+} > Li^{+}$

⬭ $Li^{+} > Na^{+} > Mg^{2+}$ [1]

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Do not write in this space

26) Two reactions are shown in **Figure 26.1**.

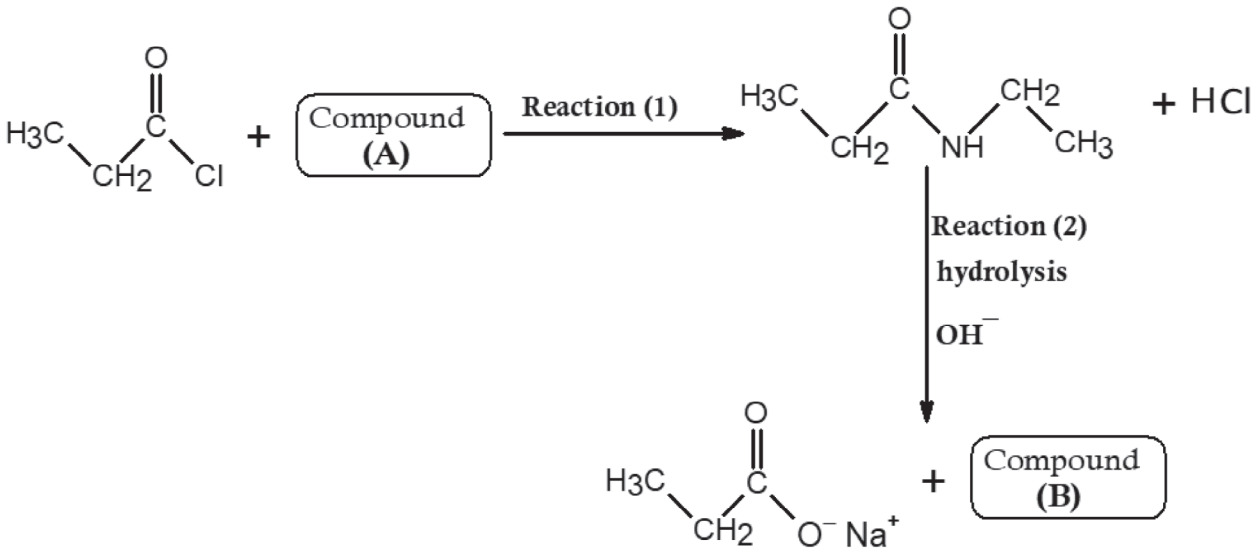


Figure 26.1

a. What is the temperature used for Reaction **(1)**?

_____ [1]

b. Draw the structural formula of:

Compound (**A**): _____

Compound (**B**): _____ [2]

27) Which of the following formulae is the general structural formula for primary amines?

(Shade in the bubble (⬭) next to the correct answer.)

⬭ $RCH(NH_2)COOH$ ⬭ RNH_2

⬭ $RCONHR'$ ⬭ $RNHR'$ [1]

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28) Three nitrogen compounds are shown in **Table 28.1**.

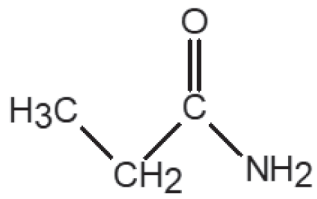
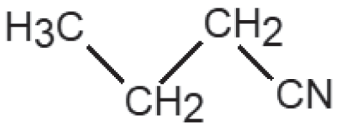
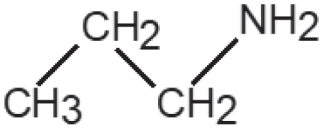
A	B	C
		

Table 28.1

a. Name compound **(A)**.

_____ [1]

b. What is the formula of the compound produced by the reduction of compound **(B)**?

_____ [1]

c. Explain why compound **(C)** is more basic than compound **(A)**.

_____

_____ [1]

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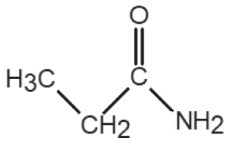
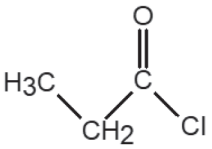
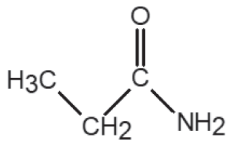
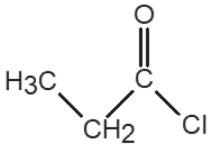
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29) Which option is **correct** about Compound **(A)** and the type of reaction below?

(Shade in the bubble (⬭) next to the correct answer.)



	Type of the reaction	Compound (A)
⬭	Hydrolysis	
⬭	Hydrolysis	
⬭	Reduction	
⬭	Reduction	

[1]

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30) Write the type of each nitrogen compound in **Table 30.1.**

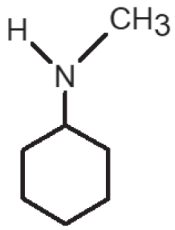
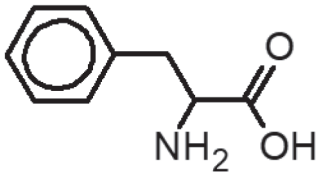
Compound	Type
	
	

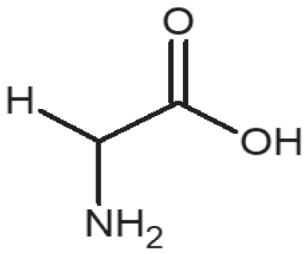
Table 30.1 [2]

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31) The amino acid (glycine) is shown in **Figure 31.1.**



Glycine, Gly

Figure 31.1

a. Draw the structure of (glycine) at pH = 6.0 and pH = 3.0

(The isoelectric point of glycine is 6.0)

at pH = 6.0 at pH = 3.0 [2]

b. Draw the structure of the dipeptide **(Gly – Gly)**.

(The peptide bond formed should be **labeled**)

[2]

[End of the Examination]

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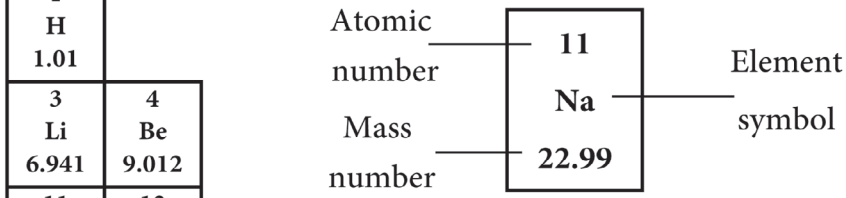
Standard electrde potentals

Electrd reaction	E^{θ}/V
$F_2(g)+2e^- \rightleftharpoons 2F^-(aq)$	+2.87
$S_2O_8^{2-}(aq)+2e^- \rightleftharpoons 2SO_4^{2-}(aq)$	+2.01
$H_2O_2(l)+2H^+(aq)+2e^- \rightleftharpoons 2H_2O(l)$	+1.77
$Pb^{4+}(aq)+2e^- \rightleftharpoons Pb^{2+}(aq)$	+1.69
$MnO_4^-(aq)+8H^+(aq)+5e^- \rightleftharpoons Mn^{2+}(aq)+4H_2O(l)$	+1.52
$PbO_2(s)+4H^+(aq)+2e^- \rightleftharpoons Pb^{2+}(aq)+2H_2O(l)$	+1.47
$Cl_2(g)+2e^- \rightleftharpoons 2Cl^-(aq)$	+1.36
$Cr_2O_7^{2-}(aq)+14H^+(aq)+6e^- \rightleftharpoons 2Cr^{3+}(aq)+7H_2O(l)$	+1.33
$O_2(g)+4H^+(aq)+4e^- \rightleftharpoons 2H_2O(l)$	+1.23
$Br_2(l)+2e^- \rightleftharpoons 2Br^-(aq)$	+1.07
$VO_2^+(aq)+2H^+(aq)+e^- \rightleftharpoons VO^{2+}(aq)+H_2O(l)$	+1.00
$VO_3^-(aq)+4H^+(aq)+e^- \rightleftharpoons VO^{2+}(aq)+2H_2O(l)$	+1.00
$ClO^-(aq)+H_2O(l)+2e^- \rightleftharpoons Cl^-(aq)+2OH^-(aq)$	+0.89
$NO_3^-(aq)+10H^+(aq)+8e^- \rightleftharpoons NH_4^+(aq)+3H_2O(l)$	+0.87
$NO_3^-(aq)+2H^+(aq)+e^- \rightleftharpoons NO_2(g)+H_2O(l)$	+0.81
$Ag^+(aq)+e^- \rightleftharpoons Ag(s)$	+0.80
$Fe^{3+}(aq)+e^- \rightleftharpoons Fe^{2+}(aq)$	+0.77
$I_2(s)+2e^- \rightleftharpoons 2I^-(aq)$	+0.54
$Cu^+(aq)+e^- \rightleftharpoons Cu(s)$	+0.52
$O_2(g)+2H_2O(l)+4e^- \rightleftharpoons 4OH^-(aq)$	+0.40
$Cu^{2+}(aq)+2e^- \rightleftharpoons Cu(s)$	+0.34
$VO^{2+}(aq)+2H^+(aq)+e^- \rightleftharpoons V^{3+}(aq)+H_2O(l)$	+0.34

Electrde reaction	E^{θ}/V
$SO_4^{2-}(aq)+4H^+(aq)+2e^- \rightleftharpoons SO_2(g)+2H_2O(l)$	+0.17
$Cu^{2+}(aq)+e^- \rightleftharpoons Cu^+(aq)$	+0.15
$Sn^{4+}(aq)+2e^- \rightleftharpoons Sn^{2+}(aq)$	+0.15
$S_4O_6^{2-}(aq)+2e^- \rightleftharpoons 2S_2O_3^{2-}(aq)$	+0.09
$2H^+(aq)+2e^- \rightleftharpoons H_2(g)$	0.00
$Fe^{3+}(aq)+3e^- \rightleftharpoons Fe(s)$	−0.04
$Pb^{2+}(aq)+2e^- \rightleftharpoons Pb(s)$	−0.13
$Sn^{2+}(aq)+2e^- \rightleftharpoons Sn(s)$	−0.14
$Ni^{2+}(aq)+2e^- \rightleftharpoons Ni(s)$	−0.25
$V^{3+}(aq)+e^- \rightleftharpoons V^{2+}(aq)$	−0.26
$Co^{2+}(aq)+2e^- \rightleftharpoons Co(s)$	−0.28
$Fe^{2+}(aq)+2e^- \rightleftharpoons Fe(s)$	−0.44
$Cr^{3+}(aq)+3e^- \rightleftharpoons Cr(s)$	−0.74
$Zn^{2+}(aq)+2e^- \rightleftharpoons Zn(s)$	−0.76
$2H_2O(l)+2e^- \rightleftharpoons H_2(g)+2OH^-(aq)$	−0.83
$Cr^{2+}(aq)+2e^- \rightleftharpoons Cr(s)$	−0.91
$Mn^{2+}(aq)+2e^- \rightleftharpoons Mn(s)$	−1.18
$V^{2+}(aq)+2e^- \rightleftharpoons V(s)$	−1.20
$Mg^{2+}(aq)+2e^- \rightleftharpoons Mg(s)$	−2.38
$Na^+(aq)+e^- \rightleftharpoons Na(s)$	−2.71
$Ca^{2+}(aq)+2e^- \rightleftharpoons Ca(s)$	−2.87
$K^+(aq)+e^- \rightleftharpoons K(s)$	−2.92

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Periodic Table



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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MARKING GUIDE GENERAL EDUCATION DIPLOMA
BILINGUAL PRIVATE SCHOOLS
SECOND SESSION – SEMESTER ONE
2025 / 2026

Note: Marking scheme in (7) sheets | Subject: Chemistry | Total marks: 70

Item	Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
					Cambr	Hodd		
1	$H_2PO_4^-$	1		**Quantitative Equilibria**	440	367	1.1.a	AO1
2	H_2O / OH^-	1			441	368	1.1.b	AO1
3	$Ka = \frac{[H^+]^2}{[C_3H_2COOH]}$ $[H^+] = \sqrt{Ka \times [C_3H_2COOH]}$ $[H^+] = \sqrt{1.3 \times 10^{-5} \times 0.10}$ $\underline{[H^+] = 1.14 \times 10^{-3}\ mol\ dm^{-3}}$ $pH = -\log[H^+] = -\log(1.14 \times 10^{-3}) = \underline{2.94}$	1 1	deduct marks once only		447	396	1.1.c	AO2
4	pH = p*K*a	1					1.1.i	AO2

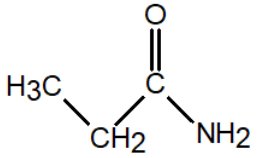
Item	Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
					Cambr	Hodd		
5	$K_a = \frac{[H^+][A^-]}{[HA]}$ Or the equilibrium constant for the dissociation of a weak acid.	1			445	396	1.1.c	AO1
6	$Fe(OH)_2(s) \rightleftharpoons Fe^{2+}(aq) + 2OH^-(aq)$ $Ksp = [Fe^{2+}][OH^-]^2$	1 1	correct balanced equation with physical states		453	375	1.1.k	AO1
7	NH_3 / NH_4Cl	1			448	396	1.1.f	AO1
8	$[Ca^{2+}]\,[CO_3^{2-}] = (2.0 \times 10^{-3})(1.5 \times 10^{-3}) = 3.0 \times 10^{-6}$ $[Ca^{2+}]\,[CO_3^{2-}] > K_{sp}$, $CaCO_3$ will precipitate.	1 1			455	375	1.1.o	AO2
9	<u>pH of buffer before adding the acid:</u> $pH = pKa + \log(\frac{[A^-]}{[HA]})$ $pH = 4.2 + \log\left(\frac{0.3}{0.2}\right)$	1			450	375	1.1.i 1.1.j	AO2

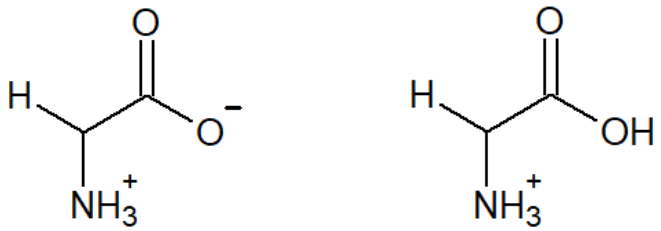
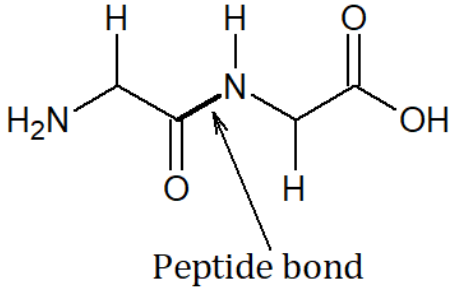
Item		Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
						Cambr	Hodd		
		$\underline{pH = 4.38}$ pH After Adding HCl: This decreases $[A^-]$ and increases [HA]: $[A^-] = 0.30 - 0.01 = 0.29$ mol dm^{-3} $[HA] = 0.2 + 0.01 = 0.21$ mol dm^{-3} $pH = 4.2 + \log\left(\frac{0.29}{0.21}\right)$ $\underline{pH = 4.34}$ pH change: pH = 4.38 − 4.34 = <u>0.04</u>	1 1 1 1						
10		Standard hydrogen electrode	1		**Electrochemistry**	411	442	2.1d	AO1
11	**a**	The concentration of ions 1.00 mol dm^{-3} The temperature is 298 K or 25 °C The rod must be pure	1+1	2 marks for any two correct.		412	442	2.1e	AO1
	b	**Anode**: Mg **Cathode:** Cu	1 1			417	442	2.1h i	AO2
	c	Metal **B** will lose electrons to the A^{2+}(aq) / A(s) half-cell.	1			413	441	2.1g, h,i	AO2

Item		Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
						Cambr	Hodd		
12	a	Br_2 V	1 1			412	444	2.1 i	AO1
	b	$E^{\ominus}_{cell} = E^{\ominus}$ (cathode) - $E^{\ominus}$ (Anode) = 0.34 – (-1.18) = +1.52V	1			417	445	2.1g	AO2
	c	$Br_2(aq) + Pb(s) \rightleftharpoons 2Br^-(aq) + Pb^{2+}(aq)$ $E^{\ominus}_{cell} = E^{\ominus}$ (cathode) - $E^{\ominus}$ (Anode) = 1.07 – (-0.13) = 1.20 v The value of the two voltages is positive - bromine will oxidise lead	1 1 1			422	447	2.1i + g	AO2
13	a	electric cell or electrolysis cell	1			406	457	2.2a	AO1
	b	W	1			406	457	2.2aii	AO1
	c	Y	1			406	457	2.2aii	AO1
14		F= L. e	1			409	450	2.2 c	AO1
15		$4OH^-(aq) \rightarrow 2H_2O(l) + O_2(g) + 4e^-$ Anode $2H^+(aq) + 2e^- \rightarrow H_2(g)$ cathode	1 1			407 408	450 451	2.2 dii	AO2

Item	Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
					Cambr	Hodd		
	Q=I· t=0.8×60×10= 480 C. From the equation: 2 moles of electrons are required per mole of H_2 formed the number of coulombs: = 2F = 2× 96500 = 193000 C mol^{-1} The volume: = 480/193000× 24.0 =0.0597 dm^3	1 1 1 1						
16	Q =I.t 3600 =0.25 (t) t =3600/0.25 t =14400 s t = 14400\60 t = 240 min	1 1 1			408	451	2.2dii	AO2
17	<table><tr><th>Anode</th><th>Cathode</th></tr><tr><td>I_2</td><td>Pb</td></tr></table>	1			409	453	2.2biii	AO2
18 **a**	(A): Li(g) (B): Br^-(g)	1 1			429	452	3.1.e	AO2

Item		Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
						Cambr	Hodd		
	b	ΔH^{o}_{latt}= ΔH^{o}_{f}[LiBr] – (ΔH^{o}_{at}[Li]+ ΔH^{o}_{at}[Br] + IE_1[Li] +EA_1[Br]) = — 819 kJ mol^{-1}	1 1					3.1.f	AO2
19		– 200 +640	1			409	451	3.1.b 3.1.e	AO2
20		Atomization energy Or ΔH^{o}_{at} First ionisation energy Or IE_1	1 1			385	329	3.1.a	AO2
21		Lattice energy: the energy changes when 1 mole of an ionic compound is formed from its gaseous ions under standard conditions.	1			393	333	3.1.a.i	AO1
22		F(g) + e$^-$ → F$^-$(g)	1			391	333	3.1.e	AO1
23		$2\Delta H^{\ominus}_{hyd}$[F$^-$]= $\Delta H^{\ominus}_{latt}$[$CaF_2$] + $\Delta H^{\ominus}_{sol}$[CaF_2] — $\Delta H^{\ominus}_{hyd}$[Ca^{2+}] $\Delta H^{\ominus}_{hyd}$[F$^-$] = — 504 kJ mol^{-1}	1 1	Accept the answer without the equation.		394	334	3.2.c	AO2
24	**a**	Na^+(g) + Br$^-$(g) → NaBr(s)	1					3.1.a	AO2
	b	<u>The lattice energy gets less exothermic as the size of the anion increases from F$^-$ to I$^-$.</u>	1					3.1.g	AO1
25		Mg^{2+} > Li^+ > Na^+	1					3.2.d	AO2
26	**a**	Room temperature	1			384	330	4.2.b.ii	AO2

Item		Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
						Cambr	Hodd		
	b	Compound (A): $CH_3—CH_2—NH_2$ Compound (B): $CH_3—CH_2—NH_2$	1 1		**Nitrogen compounds**			4.2.b.ii 4.2.c.i	AO2
27		RNH_2	1			450	450	4.1.a	AO1
28	**a**	Propanamide	1					4.2.a	AO2
	b	$CH_3—CH_2—CH_2—CH_2—NH_2$	1					4.1.c.iv	AO1
	c	Compound **(C)** is more basic than Compound **(A)** because the propyl group is electron-donating,which makes the lone pair of electrons on N atom more readily available to bond with an H^+ ion. OR In Compound **(A)** the lone pair on the nitrogen atom is in a p orbital, and can overlap with the p orbital of the adjacent carbonyl group so will be less available to bond with an H^+ ion.	1			572	451	4.2.d	AO2
29		 Reduction	1					4.1.c.iii	AO2
30		Secondary <u>amine</u> Amino acid	1 1					4.1.a 4.3.a	AO1

Item		Answer	Mark	Additional Information	Unit	Page		Learning Outcome	Assessment Objective
						Cambr	Hodd		
31	a	 at pH = 6.0 at pH= 3.0	1+1	1 mark for each		572	451	4.3.b	AO2
	b	 Peptide bond	1+1	1 mark for structure, 1 mark for the peptide bond.		576	461	4.3.c	AO2

This is the end of the Marking Guide