2019 Year 6 H2 Chemistry Preliminary Examinations Paper 1 Suggested Solutions

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	D	Α	В	В	С	А	D	А	С	D	С	D	С	В	В
Question	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Answer	D	С	С	Α	D	В	D	D	Α	С	Α	В	С	Α	В

1(D)

correct. The number of protons determine the entity of the atom/ion. Since both ⁶⁵ Cu ²⁺ and ⁶⁵ Cu ⁺ e ions of copper, they both have 29 protons. correct. ⁶³ Cu has 29 electrons and has the ectronic configuration [Ar]3d ¹⁰ 4s ¹ . Hence, ⁶³ Cu ⁺
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s the electronic configuration [Ar]3d ¹⁰ .
correct.
b. of neutrons in ${}^{63}Cu^+ = 63 - 29 = 34$
b. of neutrtons in ${}^{65}Cu^{3+} = 65 - 29 = 36$
prrect.
Cu+: [Ar]3d ¹⁰ . With a fully filled d-subshell, it has
unpaired electrons.
Cu³+ : [Ar]3d ⁸ i.e. 1, 1, 1, 1, 1
s 2 unpaired electrons.

Q2(A)

chemical formula	structure
H ₂ O ₂	H O. H
H_2S_2	H ^S S.H
N ₂ H ₄	H H H H H H H H H H H H H H H H H H H

Correct. O, S and N in the respective molecules
have 4 regions of electron density and are sp ³
hybridised. Hence, the O–H, S–H and N–H bonds
are formed from the overlap between the sp ³ hybrid
orbitals and the s orbital of H.
Correct. Since O is more electronegative than S, it
draws the O–H bond–pair in H–O–O closer to itself,
compared to S drawing the S-H bond-pair in
H-S-S to itself. The O-H bond-pair in in H-O-O
are thus nearer to the nucleus of the central O, and
exert more repulsion than those in H–S–S.
Incorrect. Since H ₂ S ₂ has the largest number of
electrons, it has the largest and most polarisable
electron cloud out of the 3 compounds. Hence,
H ₂ S ₂ has the strongest id-id interactions.
Incorrect. N ₂ H ₄ has 2 lone-pairs of electrons and 4
hydrogens, it forms an average of 2 hydrogen
bonds per molecule. H2O2 has 4 lone-pairs of
electrons and 2 hydrogens, it also forms an average
of 2 hydrogen bonds per molecule.

Q3(B)

CH₃CH₂CO₂Na dissociates in water to form CH₃CH₂CO₂⁻ and Na⁺ ions which form strong ion-dipoles interactions with water, allowing it to have high solubility in water. The dissolution is also accompanied by an increase in entropy, favouring the dissolution

While $CH_3CH_2CH_2NH_2$ forms hydrogen bonds with water, $CH_3CH_2CH_2Cl$ forms pd-pd interactions with water and $CH_3CH_2CH_2CH_3$ forms id-id interactions with water, these are not as strong as the ion-dipole interactions $CH_3CH_2CO_2Na$ form with water.

Q4(B)

The number of moles of air, n_{air} , in the dented and undented plastic ball are the same.

Using data from the dented ball,

$$n_{air} = \frac{pV}{RT} = \frac{(100000)(27.5 \times 10^{-6})}{(8.31)(273 + 22)}$$
$$= 0.001122 \text{ mol}$$

At 57 °C when the ball is restored,

$$n_{air} = 0.001122 = \frac{(p)(30.0 \times 10^{-6})}{(8.31)(273 + 57)}$$

Q5(C)

0.010 mol of A_lCl_3 , SiC l_4 and PC l_5 were added to 1.0 dm³ (i.e. excess) water.

 $\mathsf{A}l\mathsf{C}l_3+\mathsf{6}\mathsf{H}_2\mathsf{O}\to [\mathsf{A}l(\mathsf{H}_2\mathsf{O})_6]^{3+}+\mathsf{3}\mathsf{C}l^-$

• a weakly acidic solution due to $[Al(H_2O)_6]^{3+}$. Highest pH of the three resultant solutions.

 $SiC\mathit{l}_4 + 2H_2O \rightarrow SiO_2 + 4HC\mathit{l}$

• a strongly acidic solution due to formation of HC*l* which dissolves in water.

 $PCl_5 + 4H_2O \rightarrow H_3PO_4 + 5HCl$

 a strongly acidic solution due to formation of HCl which dissolves in water. Since more HCl is produced compared to SiCl₄, the resultant solutuion is more acidic and pH is the lowest of the three resultant solutions. Q6(A)

- 1 Incorrect. HI is less volatile than HBr and the difference in their volatility (i.e. boiling point) is due to the different strengths of their intermolecular forces and not the H–I and H–Br bond strengths.
- 2 Correct. The stronger H–F bond means that more energy is required to break the bond during thermal decomposition. Hence, HF is more thermally stable.
- **3** Incorrect. Since $E^{\ominus}(Cl_2/Cl^-) = +1.36V$ is more positive than $E^{\ominus}(Br_2/Br^-) = +1.07V$, Cl_2 has a greater tendency to be reduced than Br_2 i.e. Cl_2 is a stronger oxidising agent than Br_2 . The stronger bond energy of Cl-Cl (+244 kJ mol⁻¹) compared to Br-Br (+193 kJ mol⁻¹) seems to contradict the conclusion from the E^{\ominus} values. This is because there are other factors which contribute more significantly to the oxidising power of Cl_2 than simply the bond strength of the Cl-Cl bond.

Q7(D)

heat released during combustion = $mc\Delta T$

$$=(1000)(4.18)(85-25)$$

= 250800 J

Since process is 60% efficient,

theoretical amt of heat released

 $=\frac{250800}{0.6}=418000$ J

 M_r of ethyl mercaptan = 2(12.0)+6(1.0)+32.1

 ΔH per mole of ethyl mercaptan

$$= -\frac{418000}{17.0/62.1} = 1527000 \text{ J mol}^{-1}$$

 $= -1527 \text{ kJ mol}^{-1}$

Since reaction 1 involved the combustion of

2 mol of ethyl mercaptan,

 ΔH of reaction 1 = 2 x -1527 = -3054 kJ mol⁻¹

Q8(A)

Since the total volume of every experiment is the same (100 cm³), V_{reactant} \propto [reactant].

Using expression for rate provided,

	•
experiment	rate of reaction
1	20.0 / 1 = 20.0
2	20.0 / 2 = 10.0
3	20.0 / 2 = 10.0
4	10.0 / 0.5 = 20.0

Comparing experiment 1 and 2,

- when volume of H⁺ x 2, rate x 2
- order of reaction w.r.t. H⁺ = 1

Comparing experiment 1 and 4,

- when volume of $I_2 x 2$, rate remains the same
- order of reaction w.r.t. $I_2 = 0$

Comparing experiment 1 and 3,

- when volume of $CH_3COCH_3 \times 2$, rate x 2
- order of reaction w.r.t. CH₃COCH₃ = 1

Therefore, rate = $k[CH_3COCH_3][H^+]$.

1	Correct. Calculating units for rate constant:
	rate = k[CH ₃ COCH ₃][H ⁺]
	mol dm ⁻³ min ⁻¹ = k (mol dm ⁻³) ²
	$k = mol^{-1} dm^3 min^{-1}$
2	Correct. When volume of H ⁺ x 4 from experiment 5
	to 4, rate should x 4 i.e. rate of experiment 5
	$= \frac{1}{4}(20.0) = 5.0.$
	x = time taken in expt $5 = 10.0 / 5 = 2.0$ min.
3	Incorrect. Since the order of reaction w.r.t iodine is
	0, changing the concentration of iodine does not
	change the reaction rate. However, since double
	the concentration of iodine is consumed at the
	same rate, the time taken for each experiment will
	be doubled.

Q9(C)

Since steps 1 and 2 are part of a chain reaction, steps 1 and 2 continue in succession during the reaction.

	5
1	Correct. Since Cl• is consumed in step 1 and
	regenerated in step 2, it is a catalyst of the chain
	reaction.
2	Correct. Steps 1 and 2 are part of a chain reaction.
	step 1: $Cl \bullet + O_3 \Box Cl O \bullet + O_2$
	step 2: $C/O \bullet + O_3 \longrightarrow Cl \bullet + 2O_2$
	step 1: $Cl \bullet + O_3 \Box Cl O \bullet + O_2$
	step 2: $ClO\bullet + O_3 \longrightarrow Cl\bullet + 2O_2$
	Since ClO• is consumed in step 2 and regenerated
	in step 1, it is a catalyst of the chain reaction.
3	Incorrect. Since step 2 is the slow step, it has a
	higher activation energy than step 1.
4	Correct. Since the reaction is catalysed, the
	activation energy of every step of the mechanism is
	lower than the activation energy of the uncatalysed
	reaction.

Q10(D)

From the slow step, rate = $k_2[C/O\bullet][O_3]$. The overall rate equation cannot contain any intermediates, such as $C/O\bullet$. Find a mathematical equation which will allow $[C/O\bullet]$ to be substituted.

From the fast step, $K_1 = \frac{[CIO][O_2]}{[CI][O_3]} \Rightarrow [CIO] = \frac{K_1[CI][O_3]}{[O_2]}$

Therefore, rate = $k_2[ClO\bullet][O_3]$ becomes

rate =
$$k_2 \frac{K_1[C/][O_3]}{[O_2]}[O_3] = k_2 K_1 \frac{[C/][O_3]^2}{[O_2]}$$

Q11(C)

When the temperature is increased from 480 K to 550 K, the rates of both the forward and backward reactions increase because both the rate constants of the forward and backward reactions increase i.e. k_f and k_b increase.

Since the forward reaction is exothermic, increasing the temperature favours the backward endothermic reaction, decreasing the yield and the value of K_p .

Q12 (D)

$$K_{p} = \frac{1}{P_{NH_{3}} \times P_{BF_{3}}}$$

We use pV = nRT to convert the partial pressure of NH₃ to [NH₃] in mol dm⁻³. Let V be volume in dm³.

$$P_{NH_3}\left(\frac{V}{1000}\right) = n_{NH_3}RT$$
$$P_{NH_3} = 1000RT\left(\frac{n_{NH_3}}{V}\right) = 1000RT[NH_3]$$

Substituting the above into the K_p expression.

$$K_{p} = \frac{1}{P_{BF_{3}} \times 1000RT[NH_{3}]}$$
$$[NH_{3}] = \frac{1}{P_{BF_{3}}(1000)(8.31)(298)K_{p}}$$

Q13(C)

Even though HF and HC*l* have the same pH (i.e. the [H⁺] at equilibrium is the same), the solution of HF required a greater amount of NaOH for neutralisation, implying that the total amount of HF is greater than the total amount of HC*l*. This means that HF is a weak acid, while HC*l* is a strong acid.

Α	Incorrect. Since HCl is a stronger acid than HF, the
	conjugate base of HCl i.e. Cl^- is more stable F ⁻ , the
	conjugate base of HF.
В	Incorrect. While it is true that H–F is more polar than
	H–C l , this fact cannot be inferred from the given
	information.

С	Correct,	since	the	evidence	shows	that	ΗF	is	а
	weak ac	id and	HC <i>l</i>	is a strong	g acid.				

D Incorrect. 1 mol of HF and 1 mol of HC*l* each releases only 1 mol of H⁺.

Q14(B)

You need to determine which mixture of FA1 and FA2 will result in a buffer solution i.e. a mixture of a weak acid and its conjugage base. Let glutamic acid, a weak dibasic acid, be represented by H_2A .

Depending on the relative amounts of H₂A and NaOH, the following reactions could occur.

Reaction (1) : $H_2A + OH^- \rightarrow HA^- + H_2O$ Reaction (2) : $HA^- + OH^- \rightarrow A^{2-} + H_2O$

Α	Amt of H ₂ A = (50/1000)(0.1) = 0.005 mol
	Amt of NaOH = (10/1000)(0.5) = 0.005 mol
	Mole ratio of H ₂ A : NaOH = 1 : 1
	Reaction (1) occurs and all H ₂ A is completely
	neutralised.
	Resultant solution contains only HA ⁻ .
В	Correct.
	Amt of H ₂ A = (50/1000)(0.1) = 0.005 mol
	Amt of NaOH = (15/1000)(0.5) = 0.0075 mol
	Mole ratio of H ₂ A : NaOH = 1 : 1.5
	Reaction (1) and (2) occurs. H ₂ A is completely
	neutralised and some of the HA ⁻ further reacts
	with NaOH to form A ^{2–} .
	Resultant solution contains only HA ⁻ and A ²⁻ .
	This is a buffer solution.
С	This is a buffer solution. Amt of H ₂ A = (50/1000)(0.1) = 0.005 mol
С	This is a buffer solution.Amt of $H_2A = (50/1000)(0.1) = 0.005$ molAmt of NaOH = $(20/1000)(0.5) = 0.01$ mol
С	This is a buffer solution. Amt of $H_2A = (50/1000)(0.1) = 0.005 \text{ mol}$ Amt of NaOH = $(20/1000)(0.5) = 0.01 \text{ mol}$ Mole ratio of H_2A : NaOH = 1 : 2
С	This is a buffer solution. Amt of $H_2A = (50/1000)(0.1) = 0.005 \text{ mol}$ Amt of NaOH = $(20/1000)(0.5) = 0.01 \text{ mol}$ Mole ratio of H_2A : NaOH = 1 : 2 Reaction (1) and (2) occurs. All H_2A is neutralised
C	This is a buffer solution. Amt of $H_2A = (50/1000)(0.1) = 0.005 \text{ mol}$ Amt of NaOH = $(20/1000)(0.5) = 0.01 \text{ mol}$ Mole ratio of H_2A : NaOH = 1 : 2 Reaction (1) and (2) occurs. All H_2A is neutralised to form HA ⁻ . The remaining NaOH completely
С	This is a buffer solution. Amt of $H_2A = (50/1000)(0.1) = 0.005 \text{ mol}$ Amt of NaOH = $(20/1000)(0.5) = 0.01 \text{ mol}$ Mole ratio of H_2A : NaOH = 1 : 2 Reaction (1) and (2) occurs. All H_2A is neutralised to form HA ⁻ . The remaining NaOH completely neutralises HA ⁻ as well forming A ²⁻ .
С	This is a buffer solution. Amt of $H_2A = (50/1000)(0.1) = 0.005 \text{ mol}$ Amt of NaOH = $(20/1000)(0.5) = 0.01 \text{ mol}$ Mole ratio of H_2A : NaOH = 1 : 2 Reaction (1) and (2) occurs. All H_2A is neutralised to form HA ⁻ . The remaining NaOH completely neutralises HA ⁻ as well forming A ²⁻ . Resultant solution contains only A ²⁻ .
C	This is a buffer solution. Amt of $H_2A = (50/1000)(0.1) = 0.005 \text{ mol}$ Amt of NaOH = $(20/1000)(0.5) = 0.01 \text{ mol}$ Mole ratio of H_2A : NaOH = 1 : 2 Reaction (1) and (2) occurs. All H_2A is neutralised to form HA ⁻ . The remaining NaOH completely neutralises HA ⁻ as well forming A ²⁻ . Resultant solution contains only A ²⁻ . Amt of $H_2A = (50/1000)(0.1) = 0.005 \text{ mol}$
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C	This is a buffer solution. Amt of $H_2A = (50/1000)(0.1) = 0.005 \text{ mol}$ Amt of NaOH = $(20/1000)(0.5) = 0.01 \text{ mol}$ Mole ratio of H_2A : NaOH = 1 : 2 Reaction (1) and (2) occurs. All H_2A is neutralised to form HA ⁻ . The remaining NaOH completely neutralises HA ⁻ as well forming A ²⁻ . Resultant solution contains only A ²⁻ . Amt of $H_2A = (50/1000)(0.1) = 0.005 \text{ mol}$ Amt of NaOH = $(30/1000)(0.5) = 0.015 \text{ mol}$ Mole ratio of H_2A : NaOH = 1 : 3
C	This is a buffer solution. Amt of $H_2A = (50/1000)(0.1) = 0.005 \text{ mol}$ Amt of $NaOH = (20/1000)(0.5) = 0.01 \text{ mol}$ Mole ratio of H_2A : $NaOH = 1 : 2$ Reaction (1) and (2) occurs. All H_2A is neutralised to form HA ⁻ . The remaining NaOH completely neutralises HA ⁻ as well forming A ²⁻ . Resultant solution contains only A ²⁻ . Amt of $H_2A = (50/1000)(0.1) = 0.005 \text{ mol}$ Amt of $NaOH = (30/1000)(0.5) = 0.015 \text{ mol}$ Mole ratio of H_2A : $NaOH = 1 : 3$ Reaction (1) and (2) occurs.
D	This is a buffer solution. Amt of $H_2A = (50/1000)(0.1) = 0.005 \text{ mol}$ Amt of $NaOH = (20/1000)(0.5) = 0.01 \text{ mol}$ Mole ratio of H_2A : $NaOH = 1 : 2$ Reaction (1) and (2) occurs. All H_2A is neutralised to form HA ⁻ . The remaining NaOH completely neutralises HA ⁻ as well forming A ²⁻ . Resultant solution contains only A ²⁻ . Amt of $H_2A = (50/1000)(0.1) = 0.005 \text{ mol}$ Amt of NaOH = (30/1000)(0.5) = 0.015 mol Mole ratio of H_2A : NaOH = 1 : 3 Reaction (1) and (2) occurs. Resultant solution contains only A ²⁻ and

Q15(B)

Students need to calculate the minimum [Ag⁺] required to precipitate each silver(I) salt. To ppt Ag₃PO₄, IP > K_{sp} [Ag⁺]³ [PO₄³⁻] > 8.89 x 10⁻¹⁷ [Ag⁺]³ (1) > 8.89 x 10⁻¹⁷ [Ag⁺] > 4.46 x 10⁻⁶ mol dm⁻³

To ppt Ag₂CO₃, IP > K_{sp} [Ag⁺]² [CO₃^{2–}] > 8.46 x 10⁻¹² [Ag⁺]² (1) > 8.46 x 10⁻¹² [Ag⁺] > 2.91 x 10⁻⁶ mol dm⁻³

To ppt AgC*l*, IP > K_{sp} [Ag⁺] [C*l*⁻] > 1.77 x 10⁻¹⁰ [Ag⁺] (1) > 1.77 x 10⁻¹⁰ [Ag⁺] > 1.77 x 10⁻¹⁰ mol dm⁻³

Since AgCl requires the lowest [Ag⁺] to precipitate, AgCl precipitates first, followed by Ag_2CO_3 .

Q16(D)

Reaction 1: substitution Reaction 2: (intramolecular) condensation Reaction 3: reduction Reaction 4: addition

Q17(C)



D Benzene does not undergo free radical substitution readily.

Q18(C)

Option **D** is the product formed from substitution of –Br with –OH which does not happen significantly with hot ethanolic KOH. Hot aqueous KOH is usually used to achieve this transformation.

Hot ethanolic KOH causes elimination to occur giving rise to options **A**, **B** and **C** as possible products. **C** is the major product because it is the most substituted alkene.

Q19(A)

1

$$CH_2=CH_2 \xrightarrow{H_2/Ni} CH_3CH_3$$

$$\begin{array}{ccc} 3 & O & \\ & & \\$$

4
$$CH_3CN \xrightarrow{\text{LiA}/H_4} CH_3CH_2NH_2$$

Note: Option 4 can be achieved using H_2/Ni , heat but options 1 and 4 was not provided as a possible choice.

Q20(D)



Q21(B)



	· · · · ·
Α	Incorrect. Hot acidified potassium dichromate can
	be used to distinguish X and Y because it oxidises
	the aldehyde group in X but is unable to oxide Y .
В	Correct. Sodium carbonate is unable to distinguish
	X and Y because both X and Y do not contain the
	-COOH to react with sodium carbonate.
С	Incorrect. Neutral iron(III) chloride can be used to
	distinguish X and Y because it forms a violet
	complex due to the phenol group in X but is unable
	to react with Y.
D	Incorrect. Tollens' reagent can be used to
	distinguish X and Y because it forms a silver mirror
	due to reaction with the aldehyde group in X but is
	unable to react with Y.

Q22(D)

After heating compound **D** (C_8H_9X) with ethanolic AgNO₃, ppt was observed after 15 mins.

- Nucleophilic substitution of D occurred
 ⇒ D contains a halogenoalkane group.
- Since C:H ≈ 1:1, D contains a benzene ring.
- Since the ppt took a longer time to produce, the C–X bond is stronger than C–Br bond \Rightarrow X is C*l*.





inactive.

Q24(A)

Α	Correct.
	N_{β} – tertiary amine; N_{α} - substituted phenylamine;
	N_{γ} – amide. Since aliphatic amines are more basic
	than phenylamines are more basic than amides,
	basicity : $N_{\beta} > N_{\alpha} > N_{\gamma}$ and pK_{b} : $N_{\beta} < N_{\alpha} < N_{\gamma}$.
В	Incorrect. N _{β} and N _{α} each react with 1 mol of
	ethanoic acid in an acid-base reaction but N_{γ} ,
	being an amide, is not basic and does not react
	with ethanoic acid i.e. 1 mol of E reacts with only 2
	mol of ethanoic acid.
С	Incorrect. N _{α} reacts with 1 mol of CH ₃ COC <i>l</i> to form
	the respective amide and the primary alcohol
	reacts with 1 mol of CH ₃ COC <i>l</i> to form the
	respective ester.
	N_{β} , being a tertiary amine, and N_{γ} , being an amide,
	do not react with CH ₃ COC <i>l</i> .
	Therefore, 1 mol of E reacts with 2 mol of
	CH ₃ COC <i>l</i> .
D	Incorrect. 2,4-DNPH forms an orange ppt with
	aldehydes or ketone only. The only C=O present
	in E is part of an amide and hence does not form
1	an orange pot with 2 4-DNPH

Q25(C)

This question requires students to identify possible fragments from the basic hydrolysis of the cyclic polypeptide.

Option 1 is clearly incorrect because the $-CONH_2$ amide group should have been hydrolysed under these conditions.



Q26(A)

From the equation, it can be seen that Zn is oxidised to $Zn(OH)_2$, hence forms the anode; MnO_2 is reduced to Mn_2O_3 , hence forms the cathode.

Together with the diagram, it can be seen that Zn is electrode of the anode, while graphite is the electrode of the cathode.

- 1 Correct. At the cathode, which contains the graphite electrode, MnO₂ takes in electrons to be reduced to Mn₂O₃, making graphite the positive electrode.
- **2** Correct. In this battery, MnO_2 is reduced preferentially over $Zn(OH)_2$. Hence, it can be deduced that $E^{\ominus}(MnO_2/Mn_2O_3) > E^{\ominus}(Zn(OH)_2/Zn)$.
- 3 Incorrect. Increasing the volume of KOH paste does not change the concentration of OH⁻ available. Hence, the position of equilibrium of Zn(OH)₂/Zn half-cell remains the same, $E(Zn(OH)_2/Zn) = E^{\ominus}(Zn(OH)_2/Zn)$, E_{cell} remains unchanged.

Q27(B)

The organic acid releases H^+ in aqueous solution and is reduced to H_2 in the cathode of the electrolytic cell.

$$2H^+ + 2e^- \rightarrow H_2$$

 $It = n_e F \Rightarrow n_e = (6.0)(6 \times 60) / 96500 = 0.02238 \text{ mol}$

From above equation, amt of $H^+ = 0.02238$ mol.

Since the organic acid is monobasic, amt of organic acid = 0.02238 mol.

 $M_r \approx 2 / 0.02238 = 89.7$ (approximate since mass of organic acid is approximate).

89.7 = 12.0+3(1.0)+n[12.0 + 2(1.0)]+12.0+ 2(16.0) + 1.0 n ≈ 2 i.e. the organic acid is $CH_2(CH_2)_2COOH$.

Q28(C)

(1) $SO_{4^{2-}} + 4H^{+} + 2e^{-} \rightleftharpoons SO_{2} + 2H_{2}O$ $E^{\ominus} = +0.17 \text{ V}$ (2) $Zn^{2+} + 2e^{-} \rightleftharpoons Zn$ $E^{\ominus} = -0.76 \text{ V}$ Overall: $SO_{4^{2-}} + 4H^{+} + Zn \rightarrow SO_{2} + 2H_{2}O + Zn^{2+}$ $E_{coll}^{\ominus} = 0.17 - (-0.76) = +0.93 \text{ V}$

LCell	
Α	Incorrect. Using a smaller piece of Zn electrode
	has no effect on E^{\ominus} (Zn ²⁺ /Zn) and no effect on
	$E_{\text{cell}}^{\ominus}$.
В	Incorrect. Adding concentrated NH ₃ into the
	(Zn ²⁺ /Zn) half-cell causes the following reaction to
	take place. $Zn^{2+} + 4NH_3 \rightarrow [Zn(NH_3)_4]^{2+}$
	The position of equilibrium (2) to shift to the left and
	E(Zn ²⁺ /Zn) becomes more negative. Hence, E _{cell}
	becomes more positive.
С	Correct. Adding Ba(NO ₃) ₂ into the (SO ₄ ^{2–} /SO ₂)
	half-cell forms a ppt of BaSO4 which decreases
	[SO ₄ ²⁻] in the half-cell. The position of equilibrium
	(1) to shift to the left and $E(SO_4^2-/SO_2)$ becomes
	less positive. Hence, Ecell becomes less positive.
D	Incorrect. Decreasing the pressure of SO ₂ in the
	(SO _{4²⁻/SO₂) half-cell This causes the position of}
	equilibrium (1) to shift to the right and
	$E(SO_4^{2-}/SO_2)$ becomes more positive. Hence, E_{cell}
	becomes more positive.

Q29(A)

At the negative electrode, reduction occurs. For each bottle of solution, either reduction of H_2O (resulting in effervescence of H_2) or reduction of the cations (resulting in increase in mass of the electrode) can occur.

	<i>E</i> ^o / V	
H ₂ O	2H ₂ O + 2e ⁻ ≓ H ₂ + 2OH ⁻	-0.83
Ag+	Ag⁺ + e⁻ ⇒ Ag	+0.80
Zn ²⁺	Zn²+ + 2e⁻ ≓ Zn	-0.76
Mg ²⁺	Mg²+ + 2e⁻ ≓ Mg	-2.38

Solution containing Ag+

In the original solution, the reduction of Ag⁺ is preferred due to its significantly more positive E^{\ominus} value.

In a diluted solution of Ag⁺, [Ag⁺] is lower, causing the position of equilibrium of Ag⁺ + e⁻ \rightleftharpoons Ag to shift to the left causing the resultant E value to be less than +0.80 V. However, it is not possible for the value to decrease below -0.83V (the E^{\ominus} value for the reduction of water). Hence, in diluted solutions, reduction of Ag⁺ still occurs preferentially over the reduction of water.

This means that in both the original solutions and diluted solutions, reduction of Ag^+ occur, forming more Ag(s) which coats the electrode, increasing its mass. **X** contains Ag^+ .

Solution containing Zn2+

In the original solution, the reduction of Zn^{2+} is preferred due to its slightly more positive (less negative) E^{\ominus} value.

In a diluted solution of Zn^{2+} , $[Zn^{2+}]$ is lower, causing the position of equilibrium of $Zn^{2+} + 2e^- \rightleftharpoons Zn$ to shift to the left, causing the resultant E value to be more negative than -0.76 V. If sufficiently dilute, it is possible for the value to decrease below -0.83V (the E^{\ominus} value for the reduction of water) due to the E^{\ominus} values being very close. Hence, in diluted solutions, reduction of H₂O occurs preferentially over the Zn^{2+} .

This means that in the original solution, reduction of Zn^{2+} occurs and the electrode increases in mass; in the diluted solution, reduction of H₂O occur, causing effervescence of H₂(g).

Solution containing Mg²⁺

In the original solution, the reduction of H_2O is preferred due to its more positive (less negative) E^{\ominus} value.

In a diluted solution of Mg^{2+} , $[Mg^{2+}]$ is lower, causing the position of equilibrium of $Mg^{2+} + e^- \rightleftharpoons Mg$ to shift to the left. The resultant E value to be more negative than -2.38V. Hence, in diluted solutions, reduction of water still occurs preferentially over the reduction of Mg^{2+} .

This means that in both the original solutions and diluted solutions, reduction of H_2O occur, causing effervescence of $H_2(g)$.

Q30	(B)	
-		

This statement is correct. In reaction 1, there is		
negligible change in entropy since the number of		
particles in the reactants and products are the		
same. In reaction 2, there are more particles in the		
products than the reactants. Hence the entropy		
change in reaction 1 is less positive than in		
reaction 2.		
This statement is incorrect. Due to the greater		
increase in entropy of reaction 2, the forward		
reaction of reaction 2 is entropically driven and is		
more favoured. Hence the stability constant of		
[Ni(H ₂ NCH ₂ CH ₂ NH ₂) ₃] ²⁺ is larger.		
This statement is correct.		
This statement is correct. H ₂ NCH ₂ CH ₂ NH ₂ is a		
bidentate ligand and 3 of them displaced 6 H ₂ O		
ligands in reaction 2. Hence the 3 H ₂ NCH ₂ CH ₂ NH ₂		
ligands takes up the 6 coordination sites		
previously occupied by the 6 H ₂ O ligands. In both		
complexes, the coordination number of Ni is 6 and		
hence both are octahedral complexes.		