2022 Y6 Preliminary Examination H2 Chemistry 9729 Paper 1 Suggested Solutions

				/ 110	woi	rtoy				
1	2	3	4	5		6	7	8	9	10
В	Α	Α	В	D		D	С	В	С	D
11	12	13	14	15		16	17*	18	19	20*
D	С	С	В	Α		Α	Α	С	D	В
21	22	23*	24	25*		26*	27	28	29	30
D	С	D	В	Α		Α	С	В	С	D

Answer Kev

1	В					
	Give	Given:				
	angl	angle of deflection $\propto \frac{q}{m}$				
	$+15^{\circ} = k(\frac{+1}{1})$					
	, r	= +15				
	-5°	$= +15(\frac{q}{m})$				
	$\frac{q}{m} = -\frac{1}{3}$					
×	A	q = 0 m = 1+2 = 3 $\Rightarrow \frac{q}{m} \neq -\frac{1}{3}$				
~	В	q = +3-5 = -2 m = 3+3 = 6 $\Rightarrow \frac{q}{m} = -\frac{1}{3}$				
×	с	q = +4-1 = +3 m = 4+5 = 9 $\Rightarrow \frac{q}{m} \neq -\frac{1}{3}$				
×	D	q = +4-3 = +1 m = 4+5 = 9 $\Rightarrow \frac{q}{m} \neq -\frac{1}{3}$				

2	Α
	Interpretation of the graph: C is likely to be in Group
	1 since it has the lowest 1 st IE. Since the four
	elements are consecutive, B is in Group 18 and A is
	in Group 17.





4	В			
×	A	H CH_3 H CH_3 This hydrocarbon is a non-polar molecule		
*	В	$ \begin{array}{c} \underset{0}{\overset{\leftarrow}{\leftarrow}} \overset{CH_3}{\underset{0}{\overset{\leftarrow}{\leftarrow}}} \\ \overset{O}{\overset{\leftarrow}{\leftarrow}} \overset{\leftarrow}{\overset{\leftarrow}{\leftarrow}} \\ \overset{O}{\overset{\leftarrow}{\leftarrow}} \\ \overset{O}{\overset{O}{\overset{\leftarrow}{\leftarrow}}} \\ \overset{O}{\overset{O}{\overset{O}{\overset{\leftarrow}{\leftarrow}}} \\ \overset{O}{\overset{O}{\overset{O}{\overset{\leftarrow}{\leftarrow}}} \\ \overset{O}{\overset{O}{\overset{O}{\overset{\leftarrow}{\leftarrow}}} \\ \overset{O}{\overset{O}{\overset{O}{\overset{O}{\overset{O}{\overset{O}{\overset{O}{\leftarrow}}}} \\ \overset{O}{\overset{O}{\overset{O}{\overset{O}{\overset{O}{\overset{O}{\overset{O}{\overset{O}$		
×	С	$\begin{array}{c} H_{3}C & \overbrace{C}^{\delta-} \\ & \overbrace{C}^{\delta-} & \overbrace{C}^{\delta+} \\ & \overbrace{C}^{\delta-} & \overbrace{C}^{\delta+} \\ & \overbrace{C}^{\delta-} & CH_{3} \end{array}$ C-C/ bond is polar but the dipole moments cancel out.		
×	D	C/δ_{-} C=O bond is more polar than C–C/ bond as O is more electronegative than C/ but since both bonds are polar, there will be some degree of offset of dipole moments of the bonds, hence this molecule does not have the largest overall dipole moment among the four options.		

5	D
	Both CO ₂ and Cl ₂ are non-polar molecules with weaker instantaneous dipole-induced dipole interactions (id-id) as compared to CH ₃ OH and N ₂ H ₄ , which have stronger intermolecular hydrogen bonding. N ₂ H ₄ has more extensive hydrogen bonds (an average of 2 H-bonds per molecule) than CH ₃ OH (an average of 1 H-bond per molecule), hence N ₂ H ₄ exhibit greatest deviation from ideal gas behaviour.

Per molecule	СН ₃ -О-Н	●● ●● H—N—N—H - 1 H H
Total no. of H atoms bonded to O/N atom(s)	1	4
No. of lone pairs on O/N atom(s)	2	2
Average no. of H bonds possible	1	2

6	D
	Possible identities of X:
	$P_4O_{10}(s) + 6H_2O(l) \rightarrow 4H_3PO_4(aq)$
	$SO_3(g) + H_2O(I) \rightarrow H_2SO_4(aq)$
	Possible identities of Y:
	Al ₂ O ₃ is insoluble in water but is amphoteric, however
	one mole of Al_2O_3 requires 6 moles of H ⁺ for neutralisation,
	$Al_2O_3(s) + 6H^+(aq) \rightarrow 2Al^{3+}(aq) + 3H_2O(l)$ hence, options A and B are incorrect as they do not match the required mole ratio stated in the question with both given options for X.
	$\begin{array}{lll} Na_2O(s) + H_2O(l) \rightarrow 2NaOH(aq) & \ensuremath{\boxtimes} & \\ Since, one mol of H_2SO_4 is completely neutralised by two mol of NaOH, oxide X is SO_3 and oxide Y is Na_2O. \end{array}$

7	С	
×	A	Polarisability pertains to ease of distortion of the anion's electron cloud and since the anion is the same, i.e. CO_3^{2-} , in both compounds, the polarisability factor is the same in both.
×	в	Melting is not the same as thermal decomposition/ thermal stability. Melting point involves change in states, not chemical composition.
¥	с	Since ionic radius of Ca ²⁺ is smaller than that of Ba ²⁺ , the charge density of Ca ²⁺ is higher. charge density $\propto \left \frac{q_+}{r_+} \right $ Ca ²⁺ has a greater polarising power and distorts the electron cloud of CO ₃ ²⁻ anion to a greater extent. The C–O covalent bond within the CO ₃ ²⁻ anions in CaCO ₃ is weakened to a greater extent as compared to that in BaCO ₃ . Hence CaCO ₃ decomposes at a lower temperature.
×	D	Lattice energy is a measure of the ionic bond strength in metal carbonates and is not a measure of their thermal stability.

8	В	В					
	Vola vapo simp	Volatility is defined as the tendency of a substance to vapourise. Since the halogens exist as non-polar simple covalent molecules, the volatility of the					
	hald insta inter	nalogens depends on the strength of the nstantaneous dipole-induced dipole (id-id) interactions between molecules.					
x	1	Both bond length and bond strength are about the covalent bond between the atoms in the					
	2	halogen molecule. Thus, these factors do not affect volatility.					
×	3	Each halogen molecule is comprised of two identical elements from Group 17. Since the elements present in each molecule is identical, the resultant halogen molecule is non-polar. Hence the electronegativity of the halogen atom has no effect on the strength of the id-id interactions					
~	4 Strength of id-id interactions increases when number of electrons in the molecule increases due to greater ease of distortion of the larger electron cloud. Hence, this statement is correct.						

9	С
	$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$
	$n(H_2SO_4) = \frac{30}{1000} \times 0.1 = 0.003 \text{ mol}$
	$n(\text{NaOH}) = \frac{40}{1000} \times 0.2 = 0.008 \text{ mol}$
	H_2SO_4 is the limiting reagent.
	$n(H_2O) = 2 \times n(H_2SO_4)$ = 2 × 0.003 = 0.006 mol
	Heat released from the reaction = $n(H_2O) \times \Delta H_{neu} $ = 0.006 × 57.3 × 1000 = 343.8 J = heat absorbed by the solution
	heat absorbed by the solution = $mc \Delta T $ 343.8 = 70 × 1 × 4.2 × $ \Delta T $ $ \Delta T $ = 1.2 °C
	Since heat is absorbed by the solution, $\Delta T = +1.2 \text{ °C}$.

10	D			
		ΔH	ΔS	ΔG
×	А	+	+	- when temperature is high enough such that $ T\Delta S > \Delta H $
×	в	-	+	 at all temperatures not just at low T
×	с	+	+	- when temperature is high enough such that $ T\Delta S > \Delta H $
✓	D	-	+	 at all temperatures

11	D	
		From the Data Booklet, E^{\ominus} / V
*		$H_2O_2 + 2H^+ + 2e^- \Rightarrow H_2O$ +1.77 $O_2 + 2H^+ + 2e^- \Rightarrow H_2O_2$ +0.68
	1	<i>E</i> _{cell} = +1.77 - (+0.68) = +1.09 V > 0
	•	Overall equation: $2H_2O_2 \rightarrow 2H_2O + O_2$
		H_2O_2 undergoes disproportionation where the oxidation state of O increases from -1 in H_2O_2 to 0 in O_2 and decreases from -1 in H_2O_2 to -2 in H_2O .
		Both MnO_4^- and Fe^{3+} are oxidising agents and will not react.
x	2	From the <i>Data Booklet</i> , both species are on the left-hand side of the equation and show tendency to undergo reduction.
		$\begin{array}{c} E^{\ominus} / V \\ MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O & +1.52 \\ Fe^{3+} + e^- \rightleftharpoons Fe^{2+} & +0.77 \end{array}$
	3	From the Data Booklet,
		$I_{2} + 2e^{-} \rightleftharpoons 2I^{-} + 0.54$ $S_{4}O_{6}^{2^{-}} + 2e^{-} \rightleftharpoons S_{2}O_{3}^{2^{-}} + 0.09$
x		<i>E</i> _{cell} = +0.54 - (+0.09) = +0.45 V > 0
		Overall equation: $I_2 + S_2O_3^{2^-} \rightarrow 2I^- + S_4O_6^{2^-}$
		I_2 oxidises $S_2O_3{}^{2-}$ to give $S_4O_6{}^{2-}$ while $S_2O_3{}^{2-}$ reduces I_2 to give $I^$
	4	Let the oxidation state of C in $HC_2O_4^-$ be x. (+1) + 2x + 4(-2) = -1 $\Rightarrow x = +3$
V		Note: The oxidation state of both C atoms in $HC_2O_4^-$ can be determined by the calculation above since they are bonded to O atoms in the same way. The oxidation state of each atom is indicated below.
		$ \begin{array}{cccccccccccccccccccccccccccccccccccc$
12	С	

The proposed reaction mechanism must fulfill two criteria:

- 1. Given that rate = $k[NO]^2[H_2]$, the slow step should involve two NO molecules and one H_2 molecule.
- 2. The overall equation should contain the products N_2 and H_2O only, as given in the question.

×	A	 Does not fulfil both criteria: Only two NO molecules involved in the slow step, missing one H₂ molecule. Final products are N₂O and H₂O, not N₂ and H₂O.
×	В	 Does not fulfil criterion (1): Only one NO molecule and one H₂ molecule involved in slow step, missing one NO molecule.
√	С	Fulfils both criteria.
×	D	 Does not fulfil (2): Products of the reaction are N₂ and H₂O₂, not N₂ and H₂O.

13 C

Let the orders of reaction with respect to \mathbf{K} , \mathbf{L} and \mathbf{M} be x, y and z respectively.

rate = $k[\mathbf{K}]^{x}[\mathbf{L}]^{y}[\mathbf{M}]^{z}$

Comparing experiments 1 and 2, keeping [L] and [M] constant, when [K] is decreased by a factor of 2.5, relative rate decreases by a factor of 2.5. Hence, reaction is 1^{st} order with respect to **K** i.e. x = 1.

Comparing experiments 2 and 3, keeping **[L]** constant, when **[K]** is increased by a factor of 5 while **[M]** is halved, relative rate increased by a net factor of 1.25. Since the reaction is first order with respect to **K**, relative rate should have increased by a factor of 5. Hence, halving **[M]** have resulted the relative rate to decrease by a factor of 4 (i.e. $5 \div 1.25 = 4$). Reaction is second order with respect to **M**, i.e. z = 2.

Mathematically,

$$\frac{\operatorname{rate}_{2}}{\operatorname{rate}_{3}} = \frac{k[\mathsf{K}]_{\mathsf{expt2}}^{\mathsf{x}}[\mathsf{L}]_{\mathsf{expt2}}^{\mathsf{y}}[\mathsf{M}]_{\mathsf{expt2}}^{\mathsf{z}}}{k[\mathsf{K}]_{\mathsf{expt3}}^{\mathsf{x}}[\mathsf{L}]_{\mathsf{expt3}}^{\mathsf{y}}[\mathsf{M}]_{\mathsf{expt3}}^{\mathsf{z}}}$$
$$\frac{0.20}{0.25} = \frac{k(0.0010)^{1}(0.08)^{\mathsf{y}}(0.80)^{\mathsf{z}}}{k(0.0050)^{1}(0.08)^{\mathsf{y}}(0.40)^{\mathsf{z}}}$$
$$\frac{4}{5} = \frac{1}{5} \left(\frac{0.8}{0.4}\right)^{\mathsf{z}}$$
$$4 = (2)^{\mathsf{z}}$$
$$z = 2$$

Comparing experiments 3 and 4, keeping **[K]** constant, when **[L]** is halved while **[M]** is doubled, relative rate increased by a net factor of 2. Since reaction is second order with respect to **M**, rate should have increased by a factor of 4. Hence, halving **[L]** have resulted the relative rate to decrease by a factor of 2 (i.e. $4 \div 2 = 2$). Reaction is first order with respect to **L**, i.e. y = 1.

Dunman High School

Mathematically,
$\frac{\text{rate}_{3}}{k[K]_{\text{expt3}}^{x}[L]_{\text{expt3}}^{y}[M]_{\text{expt3}}^{z}}$
$rate_4 \ k[K]_{expt4}^x [L]_{expt4}^y [M]_{expt4}^z$
$0.25 - \frac{k(0.0050)^{1}(0.08)^{y}(0.40)^{2}}{}$
$\overline{0.50}^{-} \overline{k(0.0050)^{1}(0.04)^{y}(0.80)^{2}}$
$\frac{1}{1} = \left(\frac{0.08}{0.08}\right)^{\nu} \left(\frac{0.40}{0.40}\right)^{2}$
2 (0.04) (0.80)
$\frac{1}{2} = \left(2\right)^{\nu} \left(\frac{1}{4}\right)$
$2^{1} = (2)^{\nu}$
<i>y</i> = 1
∴ rate = <i>k</i> [K][L][M] ²

	_					
14	В					
	$K_{\rm c} = \frac{[\rm NO]^2[\rm O}{[\rm NO]^2}$	<u>2</u>]				
		2NO ₂ (g)	11	2NO(g)	+	O ₂ (g)
	Initial <i>n</i> / mol	2.50		0		0
	Change in <i>n</i> / mol	-1.056		+1.056		+0.528
	Eqm <i>n /</i> mol	1.444		1.056		0.528
	$K_{\rm c} = \frac{\left(\frac{1.056}{0.8}\right)}{\left(\frac{1.056}{0.8}\right)}$	$\frac{\int_{-\infty}^{2} \left(\frac{0.528}{0.8}\right)}{\frac{444}{0.8}\right)^{2}}$				
	= 0.3529	U 3				
	= 0.353 r	nol dm⁻³				

15	Α	
		$2SO_{2}(g) + O_{2}(g) \rightleftharpoons 2SO_{3}(g)$ $\mathcal{K}_{c} = \frac{[SO_{3}]^{2}}{[SO_{2}]^{2}[O_{2}]}$
×	1	If the stoichiometric coefficients are halved, $SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$
		$K_{c}' = \frac{[SO_{3}]}{[SO_{2}][O_{2}]^{\frac{1}{2}}} = K_{c}^{\frac{1}{2}} \neq \frac{1}{2}K_{c}$
×	2	At dynamic equilibrium, the rates of the forward and backward reactions are equal but not zero.
~	3	By Le Chatelier's Principle, when pressure increases, the position of equilibrium shifts to the right to produce less moles of gas, favouring the forward reaction. Hence, more moles of SO_3 will be produced.
~	4	By Le Chatelier's Principle, when temperature is reduced, position of equilibrium shifts to the right to favour the forward exothermic reaction to produce heat. Rates of the forward and backward reaction will decrease but the rate of the forward reaction is decreased to a smaller extent.

2022 Y6 Preliminary Examination – H2 Chemistry 9729/01 Solutions

 16
 A

 In order for end-point to be determined, the transition range of the indicator should fall within the region of sharp pH change.

For the first end-point, the sharp pH change occurs between 5.33 and 9.73. Hence, a suitable indicator would be bromothymol blue. Thymolphthalein will not be suitable as its colour would have changed before the first equivalence point is reached.

For the second end-point, the ethyl orange would be a suitable indicator as its pH range is below 5.33. Methyl red will not be suitable since its colour would have changed before the second equivalence point is reached.

17

Α

The colours of the silver halides and their solubilities in concentrated aqueous ammonia are shown below.

AgX	colour	solubility in concentrated NH ₃
AgC <i>l</i>	white	soluble
AgBr	cream	soluble
AgI	yellow	insoluble

Hence,	beaker	1	should	be	colourless.	Yellow
precipit	ates shou	ıld	be obser	ved	for beakers 2	2 and 3.

18	С	
×	A	Half (or fish-hook) arrows should be used to represent homolytic fission and the movement of the lone electron in the chlorine radical.
×	в	A full arrow should be used to represent the bond formation between OH ⁻ and electrophilic carbon atom. Similarly, the heterolytic fission of C–Br bond should be represented by a full arrow to indicate the transfer of an electron pair to Br.
~	с	Electron movement is represented correctly using half arrows.
×	D	Electron move from regions of high electron density to low electron density. The full arrow should point from the lone pair of electrons on OH ⁻ to the electrophilic carbon. The transfer of electrons to electrophilic C from heterolytic fission of C–Br bond is incorrect as
		a bromide ion, Br^- , is formed. This is indicative that the electron pair of the C–Br bond was transferred to Br.

	_	
19	D	
×	A	A racemic mixture contains equal proportions of each enantiomer. They cancel out each other's rotation of plane-polarised light and hence there is no overall effect. It is therefore optically inactive.
×	В	Enantiomers have identical physical properties except that in the way they rotate plane- polarised light. Hence, they have the same melting points.
×	С	Enantiomers have different biological behaviour in the human body.

✓	D	Enantiomers have identical physical properties except that they rotate plane polarised light in opposite directions. Hence, they have the same solubility in the same solvent.
---	---	---





22 C

A Lewis acid catalyst is required to generate a stronger electrophile. For example,

```
FeBr_3 + Br_2 \rightarrow FeBr_4^- + Br^+
```

The electrophile Br⁺ reacts with the nucleophilic aromatic ring to form 5 atoms with sp² hybridisation (with five p orbitals overlapping) and 1 atom with sp³ hybridisation (which contains 4 σ bonds including the newly formed σ bond with the Br). Hence, the "U-shape" should have its opening pointing to the sp³ hybridised atom.



 ✓ D ✓ HNO₃(aq), followed by AgNO₃(aq) C-F bonds are considered inert (due to their high bond strength) and hence the F atoms in both compounds do not get substituted by the OH-ions in KOH 			Warm	with	KOH(aq),	then	add	excess
	1	D	HNO₃(a C–F bo high bo both co	aq), follonds a ond stro mpour os in K	lowed by Ag re consider ength) and l nds do not (INO3(ad ed iner hence f get sub	q) t (due the F a stitute	to their atoms in d by the

24	В							
	No r No a Pale	No reddish–brown ppt with Fehling's solution: No aliphatic aldehyde Pale yellow ppt with hot alkaline aq. I ₂ :						
	contains $\begin{array}{c} O & OH \\ \parallel \\ C & I \\ H_3C & H_3C - C \\ H \end{array}$							
×	A	The C=O belongs to the ester functional group and will not give a positive iodoform test. In the presence of hot alkali, the hydrolysis of the ester can occur. This forms a carboxylate ion and an alcohol. Both do not give a positive iodoform test too.						
~	в	Structure does not contain an aliphatic aldehyde. The secondary alcohol has the appropriate structure which will give a positive iodoform test.						
x	С	Aliphatic aldehyde is present. A reddish-brown ppt will be formed with Fehling's solution.						
×	D	Benzaldehyde. Gives no reddish-brown ppt with Fehling's solution but will also not give a positive iodoform test.						



		Note: the ester functional group will react with NaOH(aq) via alkaline hydrolysis if heating is involved.
×	D	Only the 2 phenolic groups and the 3 alcohol groups will undergo condensation with ethanoyl chloride. Hence, 1 mol of chlorogenic acid only reacts with 5 mol of ethanoyl chloride.

26	Α	Α		
	The	The diagrams below show the isolated part of starting		
	chlo	igent that needs to react for the synthesis of orogenic acid to happen. For the synthesis to be		
	feas	ible, the other parts of the molecule need to		
	rem	nain unreacted.		
×	1	Two steps are required: nucleophilic substitution of the Cl atom, and oxidation of the primary alcohol to the carboxylic acid. These two steps are problematic as both involve heating with a base or an acid. This will result in the hydrolysis of the ester group as well. In addition, the oxidation process will also oxidise the secondary alcohol groups on the six-membered carbon ring.		
×	2	Two steps are required: nucleophilic addition (adding HCN to the ketone), and acid hydrolysis to convert the nitrile to the carboxylic acid. Step 2 is problematic as it involves heating with an acid, resulting in the hydrolysis of the ester as well.		
~	3	One step required: reduction of ketones to secondary alcohols The use of LiA lH_4 is problematic as it will result in the reduction of the carboxylic acid (and the ester). However, we can use NaBH ₄ in this synthesis. It will allow for the selective reduction of the ketones only, as it is not strong enough to reduce the carboxylic acid (and the ester).		

27	С		
×	A	The amine containing N ₁ is a tertiary amine. It cannot undergo condensation with ethanoyl chloride.	
×	В	N ₂ belongs to an amide functional group. Amides are neutral due to the unavailability of the lone pair of electrons for donation.	
~	С	Heating with aq. H ₂ SO ₄ involves two reactions: acid hydrolysis of the amide group and 6eutralization of any basic groups Both products are cationic:	



28 В $\frac{Before the addition of NaCN(s)}{E_{Ag^{+}/Ag}^{0} = +0.80 V}$ $E_{Fe^{3^{+}}/Fe^{2^{+}}}^{0} = +0.77 V$ Since $E^{\rm o}_{\rm Ag^+/Ag}$ is more positive than $E^{\rm o}_{\rm Fe^{3+}/Fe^{2+}}$, reduction happens in half-cell 1 and oxidation happens in half-cell 2. $E_{\text{cell}}^{\Theta} = +0.80 - (+0.77) = +0.03 \text{ V}$ Electrons flow from half-cell 2 to half-cell 1. The cathode increases in mass as Ag⁺(aq) is reduced to Ag(s) and is deposited onto the cathode. After the addition of excess NaCN(s) $\overline{E_{Ag^{+}/Ag}^{o}} = +0.80 \text{ V}$ $E_{\rm Fe(CN)_6^{3^-}/Fe(CN)_6^{4^-}}^{\rm e}$ = +0.36 V Since $E^{o}_{Ag^{+}/Ag}$ is more positive than $E^{o}_{Fe(CN)_{6}{}^{3}/Fe(CN)_{6}{}^{4-}}$, reduction still happens in half-cell 1 and oxidation still happens in half-cell 2 (i.e. no change in polarity of electrodes). E_{cell}^{9} = +0.80 - (+0.36) = +0.44 V (cell potential becomes more positive)

Electrons still flows from half–cell 2 to half–cell 1. The cathode continues to increase in mass as $Ag^+(aq)$ is reduced to Ag(s) and is deposited onto the cathode.

29	C	
	At the anode:	At the cathode:
	$E_{Zn^{2+}/Zn}^{o} = -0.76 \text{ V}$	$E_{Cu^{2+}/Cu}^{\Theta} = +0.34 \text{ V}$
	$E_{Cu^{2+}/Cu}^{\overline{O}} = +0.34 \text{ V}$	$E_{\text{Zn}^{2+}/\text{Zn}}^{\Theta} = -0.76 \text{ V}$
	$E_{Ag^{+}/Ag}^{o} = +0.80 \text{ V}$	$E_{H_2O/H_2}^{\oplus} = -0.83 \text{ V}$

2022 Y6 Preliminary Examination – H2 Chemistry 9729/01 Solutions

~	1	Since $E_{Cu^{2+}/Cu}^{\Theta}$ is the most positive, Cu^{2+} will be
		preferentially reduced at the cathode.
		Since $E_{Zn^{2+}/Zn}^{e}$ is the most negative, Zn will be
✓	2	preferentially oxidised at the anode, followed by
		Cu.
		The cell voltage must be adjusted such that Ag
×	3	does not get oxidised i.e. only copper and
		metals with less positive E° than $E^{\circ}_{Cu^{2+}/Cu}$ are
		preferentially oxidised.

30	D	
×	A	Electronic configuration of Fe ³⁺ : [Ar]3d ⁵ Arrangement of electrons in 3d orbitals:
		1 1 1 1 1
×	в	Electronic configuration of Cu ²⁺ : [Ar]3d ⁹
		Arrangement of electrons in 3d orbitals:
×	с	Electronic configuration of Cr ³⁺ : [Ar]3d ³
		Arrangement of electrons in 3d orbitals:
		Electronic configuration of Ni ²⁺ : [Ar]3d ⁸
~	D	Arrangement of electrons in 3d orbitals: