Qn	Ans	Solutions				
1	D	Number of proton > electron => cation				
		Number of proton > neutron => likely contain D (highlighted by question)				
			No. of proton	No. of neutron	No. of electron	
		A. NO ₂ +	7 + 2(8)	7 + 2(8)	7 +2(8) -1*	
		B. ND ₂ H	7 + 2(1)+ 1	7 + 2(1) + 0	7 + 2(1) + 1	
		C. NDH⁻	7 + 1 + 1	7 + 1 + 0	7 + 1 + 1 +1*	
		D. ND₃H⁺	7 + 3(1) + 1	7 +3(1) + 0	7 + 3(1) + 1 -1*	
2	Α	$\begin{array}{cccc} A. & V^- \to V^{2-} & [Ar] \ 4s^2 3d^5 \\ B. & N \to N^- & 1s^2 \ 2s^2 \ 2p^4 \\ C. & Se^+ \to Se & [Ar] \ 4s^2 3d^{10} 4p^4 \\ D. & Ti \to Ti^- & [Ar] \ 4s^2 3d^3 \end{array}$				
3	В	Significant increment from 5 th to 6 th I.E.				
		Element M from period 3 and has 5 valence electrons. => Phosphorous				
		Equation 2 is format	tion of PCl ₃ ,Equation	n 3 is formation of P	<i>Cl</i> 5	
4	D	Option A: The dipole moment on the HF molecule should be larger (HF dipole moment is larger and factoring in partial cancellation of 2 smaller OH dipole moments).				
		Option B: As fluorine is more electronegative, the hydrogen bond formed between HF molecules will be stronger than the hydrogen bond formed between H ₂ O molecules.				
		Option C: The change in id-id interactions is negligible. id-id interactions are not the predominant IMF for HF and H_2O molecules.				
		Option D: H ₂ O form	s more extensive hyd	drogen bonds than H	IF.	
5	С	Option A: In BF_3 , B shared its 3 valence electrons to form 3 covalent bonds with 3 F atoms. B is electron deficient.				
		Option B: In CO, C shares its 2 valence electrons with 2 valence electrons on O (to maintain an octet electronic configuration for O). To achieve an octet electronic configuration for C, O will donate a lone pair of electrons to C and form a dative bond.				
		Option C: In NO, N shares its 2 valence electrons with the 2 valence electrons on O (to maintain an octet electronic configuration for O). N is electron deficient.				
		Option D: In SiO ₂ , which has a giant molecular structure, Si shares its 4 valence electrons with 4 oxygen atoms (which will further extends to obtain a macromolecule).				

2022 JC 2 H2 Chemistry Prelim Paper 1 Worked Solutions

6	В	Deviation depends on IMF and size of particles.			
		All 4 compounds has id-id, SO ₃ has the highest M_r .			
7	С	When an ideal gas is compressed from 20 atm to 80 atm with no further reaction, the volume is expected to change from 67.0 cm ³ to 16.75 cm ³ (instead of 15.5 cm ³ as stated in the question).			
		Option C is not a valid explanation since the dissociation of a gas would result in an observed gas volume of larger than 16.75 cm ³ (instead of 15.5 cm ³ as stated in the question).			
8	Α	From the information given, 20.0 cm^3 of 0.20 mol dm^{-3} acid reacts exactly with $40 \text{ cm}^3 0.10 \text{ mol dm}^{-3}$ of base, indicating that reacting mole ratio of acid and base is 1:1.			
		This would be inconsistent with option A since CH ₃ COOH and Ba(OH) ₂ would react in a 2:1 ratio. Hence, option A is false, making A the answer.			
9	Α	ΔH must be negative for the overall process must be exothermic since heat must be generated by the reaction to enable the heating process.			
		ΔS must be negative as indicated by the reaction equation as the reaction goes from reactants of (1 mol solid and 1 mol liquid) to products of 1 mol solid.			
		$\Delta {\pmb G}$ must be negative since the process must be spontaneous as described by the question context.			
10	С	For the decomposition of H ₂ O ₂ :			
		$\Delta H = \frac{1}{2}[-572 - (-188)] = -192 \text{ kJ mol}^{-1}$			
		$\Delta S = \frac{1}{2}[-0.325 - (-0.225)] = -0.050 \text{ kJ mol}^{-1} \text{K}^{-1}$			
		$\Delta G = \Delta H - T \Delta S = (-192) - (25 + 273)(-0.05) = -117.1 \text{ kJ mol}^{-1}$			
11	В	Ca(s) + 2H ₂ O(I) \xrightarrow{x} Ca(OH) ₂ (aq) + H ₂ (g) 2H ⁺ (aq) $a \qquad b/2$ H ⁺ (aq)			
		<i>a</i> is twice the enthalpy change of neutralisation of calcium hydroxide (option 1) <i>b</i> is enthalpy change of reaction of calcium with acid (option 2)			
12	Α	Let the formula of hydrocarbon be C _x H _y .			
		Molar ratio of carbon dioxide : hydrocarbon is 2 : 1 $\Rightarrow x = 2$			
		$C_2H_y(g) + (2 + \frac{y}{4}) O_2(g) \longrightarrow 2CO_2(g) + \frac{y}{2} H_2O(l)$			
		Since the remaining O_2 can burn up exactly 30 cm ³ of the same hydrocarbon, this means that 100 cm ³ of O_2 can burn 40 cm ³ of the hydrocarbon.			

		⇒ Molar ratio of hydrocarbon : $O_2 = 40 : 100 = 1 : \frac{5}{2}$			
		$\Rightarrow 2 + \frac{y}{4} = 2.5$			
		\Rightarrow y = 2			
		Formula of hydrocarbon is C_2H_2 .			
13	В	Amount of $SO_3^{2-} = \frac{25.0}{1000} \times 0.10 = 0.0025$ mol			
		Amount of electrons lost by 0.0025 mol of $SO_3^{2-} = 2 \times 0.0025 = 0.005$ mol			
		Amount of metallic salt = $\frac{50.0}{1000} \times 0.10 = 0.005$ mol			
		Amount of electrons gained by 0.005 mol of metal ion = 0.005 mol			
		Amount of electrons gained by 1 mol of metal ion = 1 mol			
		Oxidation state of metal in product = $+3 - 1 = +2$			
14	D	Since the concentration of acid in the solution remains constant,			
		rate = k' [CH ₃ CO ₂ CH ₂ CH ₃] where $k' = k$ [H ⁺]			
		$t_{\frac{1}{2}} = \frac{\ln 2}{k'} = \frac{\ln 2}{k[H^+]}$			
		Expt 1			
		When $[HCl] = [H^+] = 0.2 \text{ mol } dm^{-3}$,			
		$t_{\frac{1}{2}} = 31 \text{ min} \text{ (given in question)}$			
		Expt 2			
		When $[HCl] = [H^+] = 0.1 \text{ mol } dm^{-3}$ (halved),			
		$t_{1/2} = 62 \text{ min}$			
		For $[CH_3CO_2CH_2CH_3]$ to fall from 0.2 mol dm ⁻³ to 0.05 mol dm ⁻³ , it would take two $t_{\frac{1}{2}}$.			
		Time taken = $2 \times 62 = \frac{124 \text{ min}}{124 \text{ min}}$			
15	В	Option A: N ₂ O ₂ is an intermediate since it is produced in the first step and consumed in the second step.			
		Option B: Rate equation is rate = k [NO] ² [H ₂], hence the overall order of reaction is 3.			
		Option C: Refer to the rate equation above. The order of reaction with respect to H_2 is 1.			
		Option D: Refer to the rate equation above. The order of reaction with respect to NO is 2.			
16	С	3Fe + 4H₂O ≓ Fe₃O₄ + H₂			
		initial amt 3.0 2.0 0 0			
		change $-\frac{3x}{4}$ $-x$ $+\frac{x}{4}$ $+\frac{x}{4}$			

		Equilibrium amt	$3.0 - \frac{3x}{4}$	2.0 – <i>x</i>	$+\frac{x}{4}$	$+\frac{x}{4}$
17	В		salt	$K_{\rm sp} = {\sf IF}$	þ	
			Ag ₂ S	6.8 × 10 ^{−50} = [Ag ⁺	⁻ (aq)] ² (0.1)	
		[Ag ⁺ (aq)] = 8		$[Ag^+(aq)] = 8.25 \times 10^{-2}$	²⁵ mol dm ⁻³	
		CuS $6.3 \times 10^{-36} = [Cu^{2+}(aq)](0.1)$				
				$[Cu^{2+}(aq)] = 6.3 \times 10^{-3}$	⁵ mol dm ⁻³	
			SnS ₂	1.0 × 10 ⁻⁷⁰ = [Sn ⁴	+(aq)](0.1) ²	
				$[Sn^{4+}(aq)] = 1.0 \times 10^{-66}$	⁸ mol dm ⁻³	
18	D	The lower the pK_a value, the stronger the acid.				
		Strength of acid: $CH_3COOH < CH_2BrCOOH < CH_2FCOOH$			bla tha appiluanta	
		base, the stro	The three compounds given are carboxylic acids. The more stable the conjugate base, the stronger the carboxylic acid.			ble the conjugate
		CH₃COOH ⇒	H₃COOH ⇒ CH₃COO⁻ + H⁺			
		CH ₂ BrCOOH	$CH_2BrCOOH \Rightarrow CH_2BrCOO^- + H^+$			
		CH ₂ FCOOH	$FCOOH \Rightarrow CH_2FCOO^- + H^+$			
		Stability of co	conjugate base: $CH_3COO^- < CH_2BrCOO^- < CH_2FCOO^-$			
		O-H bond in	1: Correct, electronegative Br and F will draw electrons away from the in COOH, resulting in the deprotonation of H from O–H bond to be			
		easier for the acids are mo	easier for the halogenated carboxylic acids. Thus, the two halogenated carboxylic acids are more acidic than CH ₃ COOH. Also, F is more electronegative than Br			
		thus CH ₂ FCC	OOH is more	acidic than CH2BrCOOH	Ι.	°
		Statement 2 [.]	Correct elec	tropedative Br and F wil	ll heln to stah	ilise the negative
		charge on the COO ⁻ hence resulting in these two halogenated carboxylic acids				
		to be more a the conjugate	to be more acidic than CH ₃ COOH. Also, the more electronegative F will stabilise the conjugate base to a greater extent than Br thus CH ₂ FCOOH is more acidic			
		than CH ₂ BrCOOH.				
		Statement 3:	Correct, the	methyl group in CH ₃ CO	OOH is electi	ron donating and
		intensify the making CH ₃ C	negative cha COOH the we	rge on CH₃COO⁻, desta akest acid amongst the	abilising CH ₃ (three.	COO ⁻ and hence
19	Α	Standard hyd	drogen electr	ode (S.H.E) consists of	H ₂ (g) at 1 b	ar bubbling over
		platinum ele 1 mol dm ⁻³ H	ctrode coate +(aq) at 298 I	d with finely divided p K.	latinum whic	h is dipped into



	X is an aryl chloride which does not undergo hydrolysis.		
	\rightarrow mass of ppt = 0 for X		
	\Rightarrow Contradiction in D.		
	Rate of hydrolysis: Z > Y due to strength of C-Br bond weaker than C-Cl bond		
	➔ amount of AgBr > amount of AgCl		
	 Contradiction in A. → mass of AgBr > mass of AgCl 		
	Contradiction in C.		
С	Functional groups in compound P: ketone, carboxylic acid and terminal alkene		
	H ₂ , Ni reduces ketone and alkene but not carboxylic acid		
	LiAlH4 in dry ether reduces carboxylic acid and ketone but not alkene.		
Α	Partial positive sp ² hybridised carbon attracts lone pair of electrons, thus electrophilic		
	s-05# slow 0+		
	$\begin{array}{c} L C C C N \xrightarrow{C} H C C C C N \xrightarrow{C} H C C C C C C H C C C C C H C C C C C C C H C C C C C C C C$		
	H ₃ C UT3 CN C ^L sp hybridiced UI Carbon N Carbon		
	& Curly arrow shows heterolytic fission of TT bond Cttomolytic fossion of bonds form free radicals.)		
	Only a single achiral organic product is formed, no racemic mixture.		
D	Only the secondary alcohol in estradiol undergoes oxidation and turned hot orange acidified K ₂ Cr ₂ O ₇ green.		
	Only the ketone in daidzein undergoes condensation and give a yellow/orange ppt with 2,4-DNPH.		
	Only the secondary alcohol in estradiol undergoes nucleophilic substitution and give a white fume with PCl₅.		
	Both estradiol and daidzein has phenol function group that undergoes electrophilic substitution* and decolourised orange aqueous bromine. Alkene in daidzein undergoes electrophilic addition.		
	*the positions of substitution is indicated by arrows in the figure below.		
	C		



		CHCCH200H HN-CHCOONAT L CHCCH20H HN-CHCOONAT CH200H CH20HCHCOOH 2 CH200H CH20HCHCOOH 2 CH200H CH20HCH2 NHz L L L L L L L L L L L L L
27	D	Reaction A: No heat is required for condensation reaction between amine and acyl chloride
		Reaction B: No heat is required for the hydrolysis of acyl chloride.
		Reaction C: Oxidation of primary alcohol to aldehyde requires heating with immediate distillation.
		Reaction D: alkaline hydrolysis of amide requires heating under reflux. Reflux will reduce the loss of solvent (H_2O) due to prolong heating.
28	D	\bigcirc
29	С	Cu(NO ₃) ₂ (aq) + 6H ₂ O(I) → [Cu(H ₂ O) ₆] ²⁺ (aq) + 2NO ₃ ⁻ (aq)
		NH₃(aq) + H₂O(I) ≪ NH₄⁺(aq) + OH⁻(aq)
		$[Cu(H_2O)_6]^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s) + 6H_2O(I)$
		$Cu(OH)_2(s) + 4NH_3(aq) + 2H_2O(I) \ll [Cu(NH_3)_4(H_2O)_2]^{2+}(aq) + 2OH^{-}(aq)$
30	Α	Iron functions as a heterogeneous catalyst in the Haber process, via
		 the availability of energetically accessible vacant/ partially filled 3d orbitals which allow the ready exchange of electrons to and from reactant particles, thus facilitating the formation of weak bonds with the reactant particles (adsorption). the availability of 3d and 4s electrons for bond formation with reactant particles.