

## H2 Chemistry Preliminary Examination Paper 1 Worked solution

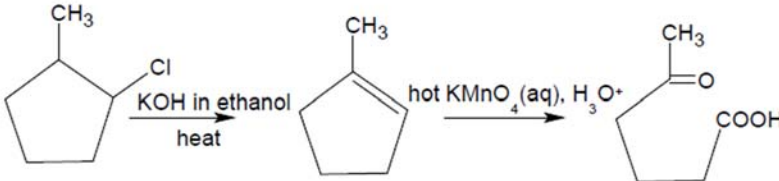
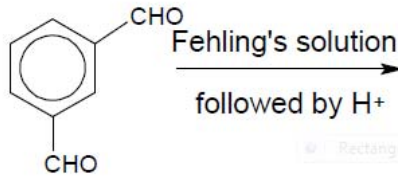
1	D	<p><b>Option A</b> is wrong: the number of atoms in 24 dm<sup>3</sup> of nitrogen gas at r.t.p. condition  <math>24 \text{ dm}^3 \text{ N}_2 \equiv 1 \text{ mol N}_2 \equiv 2 \text{ mol N} \equiv 2 \times L</math></p> <p><b>Option B</b> is wrong: the number of molecules in 1 dm<sup>3</sup> of oxygen at 273 K and 1 atm  <math>1 \text{ dm}^3 \text{ O}_2 \equiv 1/22.4 \text{ mol O}_2 \equiv 1/22.4 \times L</math></p> <p><b>Option C</b> is wrong: the number of electrons removed to form Ne<sup>+</sup> ions from <math>6.02 \times 10^{-23}</math> mol of Ne atoms          No of electrons removed = <math>(6.02 \times 10^{23}) \times (6.02 \times 10^{-23}) = 6.02^2</math> electrons</p> <p><b>Option D is correct:</b> the number of ions in 83.5 g of <math>[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2</math>          Amount = <math>83.5/250.4 = 1/3 \text{ mol}</math>  <math>1 \text{ mol } [\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2 \equiv 3 \text{ mol ions}</math>  <math>1/3 \text{ mol } [\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2 \equiv 1 \text{ mol ions} = L</math></p>
2	B	<p><b>Option A</b> is wrong: <math>{}_{26}\text{Fe} : [\text{Ar}] 3d^6 4s^2</math> (one unpaired d-orbital)</p> <p><b>Option B is correct:</b> <math>{}_{32}\text{Ge}^{2+} : [\text{Ar}] 3d^{10} 4s^2</math> (no unpaired, all paired)</p> <p><b>Option C</b> is wrong: <math>{}_{14}\text{Si} : [\text{Ne}] 3s^2 3p^2</math> (two unpaired p-orbitals)</p> <p><b>Option D</b> is wrong: <math>{}_{22}\text{Ti}^{3+} : [\text{Ar}] 3d^1</math> (one unpaired d-orbital)</p>
3	C	<p>By VSEPR theory, <math>\text{BCl}_3</math> has 3 bond pairs, and no lone pairs. This give rise to trigonal planar structure.</p> <p><math>\text{PH}_3</math> has 3 bond pairs and 1 lone pair, therefore it is trigonal pyramidal structure.</p>
4	A	<p>The molecules in option <b>A</b> are a pair of enantiomers. Enantiomers are known to have identical chemical and physical properties, with the exception of its ability to rotate plane polarised light. Therefore the enantiomers will have identical boiling point.</p>
5	B	<p><b>Option A</b> is wrong : <math>P = \frac{\rho RT}{M_r}</math></p> $\frac{P}{\rho} = kT = k (t \text{ } ^\circ\text{C} + 273) \text{ (similar to } y = mx + c \text{)}$ <p>Plot wrong as y-intercept is zero. Note temp axis is in <math>^\circ\text{C}</math> and y-intercept = <math>273k</math>.</p> <p><b>Option B is correct:</b> <math>\frac{P}{\rho} = kT = k (t + 273) \text{ (similar to } y = mx + c \text{)}</math></p> <p><b>Option C</b> is wrong: Not a linear plot of <math>y = mx + c</math></p> <p><b>Option D</b> is wrong: Not a linear plot of <math>y = mx + c</math></p>

6	C	<p>One mol of neon gas at temperature <math>T_1</math> was added to another one mol of neon and the temperature was increased to <math>T_2</math>.</p> <p>As such, the area under the curve should increase since there is an increase in the number of moles of gases.</p> <p>When temperature increases to <math>T_2</math>, the curve should tend to the right as the molecular speed should increase at a higher temperature.</p> <p><b>Option C</b> is correct</p>								
7	C	$\Delta H = (5(\text{BE}(\text{N}=\text{N}) + \text{BE}(\text{N}=\text{O}) + 2\text{BE}(\text{C}-\text{H}) + \text{BE}(\text{C}\equiv\text{C})) - (2\text{BE}(\text{O}-\text{H}) + 4\text{BE}(\text{C}=\text{O}) + 5(\text{N}\equiv\text{N})))$ $= (5(418 + 686) + 2(410) + (840)) - (2(460) + 4(740) + 5(994))$ $= -1670 \text{ kJ mol}^{-1}$								
8	B	<table border="1"><thead><tr><th>No. of quarter life</th><th>Amount of <math>^{40}\text{K}</math> left</th></tr></thead><tbody><tr><td>0</td><td>100%</td></tr><tr><td>1</td><td>25%</td></tr><tr><td>2</td><td>6.25%</td></tr></tbody></table> <p>Since two quarter life have passed, the time required would be <math>2.5 \times 10^9 \times 2 = 5.0 \times 10^9</math> years</p>	No. of quarter life	Amount of $^{40}\text{K}$ left	0	100%	1	25%	2	6.25%
No. of quarter life	Amount of $^{40}\text{K}$ left									
0	100%									
1	25%									
2	6.25%									
9	D	<p>0.785 g Cr <math>\equiv</math> 0.0151 mol Cr 8690 C <math>\equiv</math> 0.09005 mol e 0.0151 mol Cr <math>\equiv</math> 0.09005 mol e 1 mol Cr <math>\equiv</math> 5.96 mol e <math>\equiv</math> 6 mol e</p> <p><math>\text{Cr}^{n+} + ne \rightarrow \text{Cr}</math> <math>n = 6</math></p> <p><b>Option A</b> is wrong : OS of Cr = +2 <b>Option B</b> is wrong : OS of Cr = +3 <b>Option C</b> is wrong : OS of Cr = +4 <b>Option D</b> is correct: : OS of Cr = +6</p>								
10	B	<p><math>\text{Cu(s)} \mid \text{Cu}^{2+}(\text{aq}, 1 \text{ mol dm}^{-3}) \parallel \text{A}^+(\text{aq}) \mid \text{A(s)}</math></p> <p><b>Option A</b> is wrong as statement is correct : The <math>\text{Cu}^{2+}/\text{Cu}</math> half-cell is the anode and Cu is the negative electrode</p> <p><b>Option B</b> is correct as statement is incorrect : <math>[\text{A}^+(\text{aq})] = 1.00 \times 10^{-7}</math> and <math>\log [\text{A}^+(\text{aq})] = -7</math>. From the graph, emf &gt; 0 and the direction of electron flow will <b>not</b> be reversed.</p> <p><b>Option C</b> is wrong as statement is correct : <math>E_{\text{cell}}^{\ominus} = E_{\text{red}}^{\ominus} + E_{\text{ox}}^{\ominus} + 0.46 = E_{\text{red}}^{\ominus} + (-0.34) E_{\text{red}}^{\ominus} = +0.80\text{V}</math></p> <p><b>Option D</b> is wrong as statement is correct : At std conditions, <math>[\text{A}^+(\text{aq})] = 1.00 \text{ mol dm}^{-3}</math> <math>\log [\text{A}^+(\text{aq})] = 0</math> emf = +0.46 V (from graph)</p>								

11	B	<div><math display="block">\text{D(g)} \rightleftharpoons \text{E(g)} + \text{F(g)}</math><table><tr><td>Initial pressure/atm</td><td>p</td><td>0</td><td>0</td></tr><tr><td>Eqm pressure/atm</td><td><math>\frac{1p}{7}</math></td><td><math>\frac{3p}{7}</math></td><td><math>\frac{3p}{7}</math></td></tr></table><p>Note : Total pressure = p (constant)</p><math display="block">K_p = \frac{\left(\frac{3}{7} \text{ atm}\right)^2}{\left(\frac{1}{7} \text{ atm}\right)} = 9p/7 \text{ atm}</math></div>	Initial pressure/atm	p	0	0	Eqm pressure/atm	$\frac{1p}{7}$	$\frac{3p}{7}$	$\frac{3p}{7}$
Initial pressure/atm	p	0	0							
Eqm pressure/atm	$\frac{1p}{7}$	$\frac{3p}{7}$	$\frac{3p}{7}$							
12	B	<div>Method 1: Calculation –confirmation method</div> <div><math>\text{pK}_a = 9.5</math> <math>K_a = 10^{-9.5}</math> <math>[\text{paracetamol}] = [(12.78 \times 10^{-3})/151] / (1 \times 10^{-3}) = 0.084 \text{ mol dm}^{-3}</math> <math display="block">K_a = \frac{[\text{anion}][\text{H}^+]}{[\text{paracetamol}]}</math><math display="block">10^{-9.5} = \frac{[\text{anion}][\text{H}^+]}{[0.0846]}</math><math display="block">[\text{H}^+] = 5.17 \times 10^{-6}</math><math display="block">\text{pH} = -\lg[\text{H}^+] = 5.29</math></div> <div>Method 2: Elimination method – smart guess</div> <div><ul style="list-style-type: none"><li>Paracetamol behaves as weak acid, which undergoes partial dissociation</li><li>hence pH must be near to 7</li><li>Most probable pH is 5.29</li></ul></div>								
13	A	<div><math>\text{pH} = 14 - \text{pK}_b</math> <math>\text{pK}_b = 14 - \text{pH}</math> <math>\text{pK}_b = \text{pOH}</math> i.e. max buffer capacity</div> <div>Option A is correct</div>								
14	D	<div><math>\text{NH}_4^+</math> is the conjugate acid of a weak base, <math>\text{NH}_3</math>.</div> <div><math>\text{NH}_4^+</math> dissociates partially in water to produce <math>\text{H}_3\text{O}^+</math> as follows: <math display="block">\text{NH}_4^+ + \text{H}_2\text{O} \rightleftharpoons \text{NH}_3 + \text{H}_3\text{O}^+</math></div> <div><math>\text{Mg(OH)}_2(\text{s})</math> then undergoes an acid–base reaction (neutralisation) with the <math>\text{H}_3\text{O}^+</math> ions produced. <math display="block">\text{Mg(OH)}_2(\text{s}) + 2\text{H}_3\text{O}^+(\text{aq}) \longrightarrow \text{Mg}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})</math></div>								

15	D	<p>A saturated solution of <math>\text{Ca(OH)}_2</math> is found to have a pH of 12.3 at 25 °C.</p> <p><math>\text{Ca(OH)}_2 \rightleftharpoons \text{Ca}^{2+} + 2\text{OH}^- \dots \text{eqm (1)}</math></p> <p>Option A is correct: <math>K_{\text{sp}}</math> of <math>\text{Ca(OH)}_2 = [\text{Ca}^{2+}][\text{OH}^-]^2 = (1/2 \times 10^{-1.7}) (10^{-1.7})^2 = 4 \times 10^{-6} \text{ mol}^3 \text{ dm}^{-9}</math>.</p> <p>Option B is correct: The solubility of <math>\text{Ca(OH)}_2</math> would increase when temperature is raised to 35 °C.</p> <p>Option C is correct: When solid <math>\text{Na}_2\text{O}</math> is added, <math>\text{NaOH}</math> is formed, hence <math>[\text{OH}^-]</math> increases. As such, POE of eqm (1) above will shift to the left, hence <math>[\text{OH}^-]</math> decrease. The solubility of <math>\text{Ca(OH)}_2</math> will decrease.</p> <p><b>Option D is incorrect:</b> When <math>\text{Ca(NO}_3)_2</math> is added, <math>[\text{Ca}^{2+}]</math> increases. As such, POE of eqm (1) above will shift to the left, hence <math>[\text{OH}^-]</math> decrease. The pH of the solution would decrease.</p>
16	A	<ul style="list-style-type: none"> <li>• Important information in question : high charge-density cations</li> <li>• Only <math>\text{AlCl}_3</math> and <math>\text{MgCl}_2</math> will dissolve in water to give cations, <math>\text{Al}^{3+}</math> and <math>\text{Mg}^{2+}</math></li> <li>• Hence, most effective high charge-density cation is <math>\text{Al}^{3+}</math></li> </ul>
17	B	<ul style="list-style-type: none"> <li>• All of the elements burns in presence of oxygen to give respective oxides. All the metal oxides formed will be soluble in water but <math>\text{SiO}_2</math> is insoluble in water.</li> <li>• <math>\text{Al}_2\text{O}_3</math> is amphoteric oxide which reacts with <math>\text{NaOH}</math>, ie soluble in excess <math>\text{NaOH}</math> through formation of the following complex  <math>\text{Al}_2\text{O}_3(\text{s}) + 2\text{NaOH}(\text{aq}) + 3\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{Na}[\text{Al}(\text{OH})_4](\text{aq})</math></li> <li>• Both <math>\text{K}_2\text{O}</math> and <math>\text{CaO}</math> are basic oxide which do not react with <math>\text{NaOH}</math>, thus remains as white ppt.</li> <li>• However, only <math>\text{CaO}</math> will react with <math>\text{H}_2\text{SO}_4</math> to give a sparingly soluble white ppt.  <math>\text{CaO}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{CaSO}_4(\text{s}) + \text{H}_2\text{O}(\text{l})</math></li> </ul>
18	C	<ul style="list-style-type: none"> <li>• Thermal decomposition of hydrogen halides, <math>\text{HX}</math>, involves the breaking of the covalent H-X bond.</li> <li>• General trend of Group VII halides: Going down Group VII, the valence np orbital of the halogen atom is larger and more diffused. Thus, the overlap of orbitals between the 1s orbital of H and the np orbital of halogen atom becomes less effective. Consequently, the H-X bond is longer and weaker as indicated by the bond energies. Less energy is required to break the H-X bond going down the group, i.e. thermal stability decreases.</li> <li>• Conclusion : H-Cl bond is stronger than H-I bond.</li> </ul>
19	D	<p><b>Option A :</b> <math>E_{\text{cell}} = -0.59\text{V}</math>, reaction is not feasible.</p> <p><b>Option B:</b> hexacyanoferrate(III) cannot be further oxidised.</p> <p><b>Option C:</b> Sn is not a transition element, therefore while it can be oxidised from <math>\text{Sn}^{2+}</math> to <math>\text{Sn}^{4+}</math>, there is no color change.</p> <p><b>Option D is correct:</b> <math>E_{\text{cell}} = 0.97\text{V}</math>, therefore reaction is feasible. <math>\text{V}^{2+}</math> is green, and it changes to <math>\text{V}^{3+}</math> which is violet.</p>



25	C	<p>Option A:</p>  <p>Option B:</p> $\text{H}_2\text{NCO}(\text{CH}_3)_3\text{CHCH}_3 \xrightarrow[\text{heat}]{\text{KOH(aq)}} \text{OOC}(\text{CH}_3)_3\text{CH}(\text{OH})\text{CH}_3 \xrightarrow[\text{H}_3\text{O}^+]{\text{hot KMnO}_4(\text{aq})} \text{CH}_3\text{CO}(\text{CH}_2)_3\text{COOH}$ <p>Option C:</p> $\text{CH}_3\text{CH}(\text{OH})(\text{CH}_2)_3\text{CH}_2\text{Cl} \xrightarrow[\text{heat}]{\text{NaOH in ethanol}} \text{CH}_3\text{CH}(\text{OH})(\text{CH}_2)_2\text{CH}=\text{CH}_2 \xrightarrow[\text{H}_3\text{O}^+]{\text{hot KMnO}_4(\text{aq})} \text{CH}_3\text{CH}(\text{OH})(\text{CH}_2)_2\text{COOH} \text{ (major product)}$ <p>Option D: The compound oxidises to <math>\text{CH}_3\text{CO}(\text{CH}_2)_3\text{COOH}</math>.</p>
26	A	<p>The rest of the options will produce 1,3-dicarboxylic acid.</p> <p>Option A:</p>  <p>Will not be able to oxidise the compound. Only Tollens' reagent can oxidise this compound to 1,2-dicarboxylic acid.</p>
27	C	<p>Using the example of phthalic anhydride producing phthalic acid with water, ethanol should follow the same reaction as water. The general formula of the reaction is shown in the equation below.</p> $\text{C}_6\text{H}_4(\text{CO})_2\text{O} \text{ (anhydride)} + \text{ROH} \rightarrow \text{C}_6\text{H}_4(\text{COOH})\text{COOR} \quad [\text{R} - \text{CH}_3\text{CH}_2-]$
28	B	<p><b>Q</b> 1 mol of Q requires 3 mol of NaOH for the hydrolysis process.  Amount of NaOH left after hydrolysis = <math>(50/100 \times 1) - 0.03 = 0.02</math> mol  1 mol NaOH requires 1 mol of HCl for neutralisation  Vol of HCl required to neutralise the remaining NaOH = <math>0.02 / 1 = 0.02\text{dm}^3 = 20\text{cm}^3</math></p> <p><b>R</b> 1 mol of R requires 1 mol of NaOH for the hydrolysis process.  Amount of NaOH left after hydrolysis = <math>(50/100 \times 1) - 0.01 = 0.04</math> mol  1 mol NaOH requires 1 mol of HCl for neutralisation  Vol of HCl required to neutralise the remaining NaOH = <math>0.04 / 1 = 0.04\text{dm}^3 = 40\text{cm}^3</math></p> <p><b>S</b> 1 mol of S requires 2 mol of NaOH for substitution of 2 Br.  Amount of NaOH left after hydrolysis = <math>(50/100 \times 1) - 0.02 = 0.03</math> mol  1 mol NaOH requires 1 mol of HCl for neutralisation  Vol of HCl required to neutralise the remaining NaOH = <math>0.03 / 1 = 0.03\text{dm}^3 = 30\text{cm}^3</math></p>

29	B	<p>Option A: Amino acids form zwitterions not amides.</p> <p>Option B: Basicity depends on the availability of lone pairs of electron on nitrogen for coordination with proton. The lone pair of electrons on the N atom can be <u>delocalised</u> with the <math>\pi</math> electrons of the C=O double bond. This creates the resonance structure. This makes the amides less basic than amines.</p> <div data-bbox="730 443 997 772" data-label="Chemical-Block"> </div> <p>Option C: Need to concentrate on the availability of lone pairs of electrons on nitrogen, not on how it is more difficult to break the C-N bond.</p> <p>Option D: The powerful <b>electron-withdrawing effect of the carbonyl group C=O</b> reduces the electron density on the N atom, making it less effective as a proton acceptor. Not make the hydrogen atoms more acidic.</p>
30	D	<p>Option A: True</p> <p>Option B: Both glycine and alanine have non polar R groups, hence would have van der Waals' forces between them.</p> <p>Option C: Cystein is a sulfur containing amino acid which is capable of forming disulfide linkages between the cysteine molecules.</p> <p>Option D: Serine forms hydrogen bonds with another serine amino acid in the protein as the side group is an alcohol group.</p>
31	A	<p>Option 1 is correct : <math>0.0200 \text{ mol T} \equiv 0.00400 \text{ mol MnO}_4^-</math>  <math>5 \text{ mol T} \equiv 1 \text{ mol MnO}_4^-</math></p> <p>Option 2 is correct : <math>5 \text{ mol T} \equiv 1 \text{ mol MnO}_4^- \equiv 5 \text{ mol e}</math>  <math>1 \text{ mol T} \equiv 1 \text{ mol e}</math>  <math>1 \text{ mol T} \text{ lost } 1 \text{ mol e}</math>  Change in OS of T = +1</p> <p>Option 3 is correct : <math>\text{TOCl}_y \rightarrow \text{TO}_3^-</math>  <math>+4 \quad \quad +5</math>  OS of T in <math>\text{TOCl}_y = +4</math>  In <math>\text{TOCl}_y</math>, <math>+4 + (-2) + (y(-1)) = 0</math>  <math>y = 2</math></p>

32	A	<p>Option 1 is correct: The ion <math>\text{U}^{5+}</math> has the symbol <math>{}^{89}_{43}\text{U}^{5+}</math> and thus the same charge by mass ratio as yttrium ion, <math>{}^{89}\text{Y}^{5+}</math>. Both deflected to same extent.</p> <p>Option 2 is correct: <b>U</b> is the technetium, <b>Tc</b>. Electronic configuration of <b>Tc</b> is <math>[\text{Kr}] 4d^5 5s^2</math> and that of <math>\text{U}^{5+}</math> is <math>[\text{Kr}] 4d^2</math>.</p> <p>Option 3 is correct : <math>\text{U}^{2+}(\text{g}) \rightarrow \text{U}^{3+}(\text{g}) + \text{e}^-</math> (3<sup>rd</sup> IE)  <math>[\text{Kr}] 4d^5 \quad [\text{Kr}] 4d^4</math></p> <p>The energy required to remove the a mol of e from <math>\text{U}^{2+}(\text{g})</math> will be significantly higher than 2<sup>nd</sup> IE as it involves the removal of electron from an inner quantum shell.</p>
33	B	<p>Trypsin is an enzyme that catalyses the reaction. When the [substrate] (casein) is low, increasing the concentration of casein will increase the rate of reaction as there are plenty of active sites available on the catalyst, therefore its first order with respect to casein.</p> <p>However, as the concentration of casein rise, the active sites in the enzyme will be saturated, and therefore, increasing the concentration of casein will have no effect on the rate of reaction, thus it's a zero order reaction.</p>
34	B	<p>Option 1 is correct: In discharging the cell, <math>\text{Li}^+ \text{MnO}_2^-</math> will be formed. Li is oxidised to <math>\text{Li}^+</math> and electrons released will flow to the <math>\text{MnO}_2</math> electrode.</p> <p>Option 2 is correct: At the <math>\text{MnO}_2</math> electrode (cathode), <math>\text{MnO}_2</math> gains electron and is reduced to <math>\text{MnO}_2^-</math>.</p> <p>Option 3 is wrong: Water cannot be used as it will react with Li, a Group I metal.</p>
35	A	<p>Graph 1 is correct: (Explanation can be found in Pg 4 Periodicity notes)</p> <ul style="list-style-type: none"> <li>The atomic radii of the elements <u>decrease</u> across period 3 gradually. Across a period, there is an increase in the <u>effective nuclear charge</u>, due to increasing <u>number of protons</u> in the nucleus and approximately constant shielding effect.</li> <li>The radius of Ar is, in fact, the van der Waals' radius between two atoms. Hence, largest radius.</li> </ul> <p>Graph 2 is correct: explanation will use actual element and its ion to minimise confusion (Pg 4 Periodicity notes)</p> <ul style="list-style-type: none"> <li>The cationic radius decreases from atomic number 11 to 14 (which is actually <math>\text{Na}^+</math> to <math>\text{Si}^{4+}</math>) (Electronic configuration: <u><math>1s^2 2s^2 2p^6</math></u>). <ul style="list-style-type: none"> <li>Nuclear charge increases from <math>\text{Na}^+</math> to <math>\text{Si}^{4+}</math> due to an increase in protons.</li> <li>Shielding effect remains approximately constant as these cations are isoelectronic.</li> <li>Due to the increase in nuclear charge, the valence electrons in these ions are held more tightly to the nucleus, accounting for a smaller cationic radius.</li> </ul> </li> <li>The anionic radius decreases from <math>\text{Si}^{4-}</math> to <math>\text{Cl}^-</math> (Electronic configuration: <u><math>1s^2 2s^2 2p^6 3s^2 3p^6</math></u>) <ul style="list-style-type: none"> <li>Similarly for the anions (<math>\text{Si}^{4-}</math>, <math>\text{P}^{3-}</math>, <math>\text{S}^{2-}</math> and <math>\text{Cl}^-</math>) are isoelectronic (constant shielding). The decrease in anionic radii is also due to the increase in nuclear charge.</li> </ul> </li> <li>Radii of anions &gt; Radii of cations because of an <u>extra shell</u> of electrons in the anions.</li> </ul>



		<p>Graph 3 is correct: Explanation can be found in Pg 5 Periodicity notes</p> <ul style="list-style-type: none"> <li>Na, Mg and Al are metals. Conductivity increases from Na to Al due to an <u>increase</u> in the number of valence electrons donated to the delocalised electron cloud by the metal atoms.</li> <li>Si is a metalloid (having both properties of metals and non-metals). It has low conductivity. It is a <u>semi-conductor</u>.</li> <li>P, S and Cl are non-metals. The electrons are localised in covalent pairs and are unable to move to conduct electricity. They have very low conductivities. They are <u>non-conductors</u> (insulators).</li> </ul> <div style="text-align: center;"> <math display="block">  \begin{array}{ccccccc}  \text{Na} &amp; \text{Mg} &amp; \text{Al} &amp; \text{Si} &amp; \text{P}_4 &amp; \text{S}_8 &amp; \text{Cl}_2 \\  \leftarrow &amp; \text{Metals} &amp; \rightarrow &amp; \text{Metalloid} &amp; \leftarrow &amp; \text{Non-Metals} &amp; \rightarrow  \end{array}  </math> </div>
36	C	<p>Option 1: The reaction involves nucleophilic attack not electrophilic attack.</p> <p>Option 2: The RX compound is a tertiary RX hence it will be undergoing <math>\text{SN}_1</math> mechanism which involves the formation of a carbocation in the slow step.</p> <p>Option 3: The reaction involves the cleaving of C-X bond so if the X is I, the reaction will take place rapidly as the C-I bond is weaker than C-Cl bond.</p>
37	C	<p>During the reaction, C=O bond from benzaldehyde and 2 N-H bonds from phenylhydrazine will be broken. The products will have C=N bond and O-H (from water) being formed.</p>
38	D	<p>Option 1: One mole of dopamine has 1 <math>\text{-NH}_2</math> group and 2 <math>\text{-OH}</math> groups. Hence, one mole of dopamine will react with 3 moles of <math>\text{RCOCl}</math>. (the <math>\text{-NH}_2</math> group will form amide with <math>\text{RCOCl}</math> and the <math>\text{-OH}</math> group will form ester with <math>\text{RCOCl}</math>).</p> <p>Option 2: Dopamine will undergo electrophilic substitution with 3 moles of <math>\text{Br}_2(\text{aq})</math> wrt to the two phenol groups.</p> <div style="text-align: center;"> <p>Option 2:</p> </div> <p>Option 3: One mole of dopamine will react with one mole of <math>\text{Na}_2\text{CO}_3</math> as only the <math>\text{-COOH}</math> group in the compound will react.</p>
39	A	<p>Distillate W forms a yellow ppt with alkaline aq iodine – W has <math>\text{-C=O}</math> group.</p> <p>X reacts with <math>\text{Na}_2\text{CO}_3</math> – X has <math>\text{-COOH}</math> group.</p> <p>Option 1: Given the formula of V, V should have unsaturated bonds in it so it should be able to decolourise aq bromine.</p> <p>Option 2: W is a carbonyl compound so it should be able to form orange ppt with 2,4-DNPH.</p> <p>Option 3: X has <math>\text{-COOH}</math> group so it should be able to react with <math>\text{PCl}_5</math>.</p>
40	A	<p>Option 1: It can be hydrolysed to form Benzoic acid and aminoethanoic acid.</p> <p>Option 2: Benzoyl chloride and aminoethanoic acid can undergo nucleophilic substitution/condensation to form benzoylglycine and HCl as the products.</p> <p>Option 3: Cold <math>\text{NaOH}(\text{aq})</math> can react with <math>\text{-COOH}</math> group through acid-base reaction.</p>