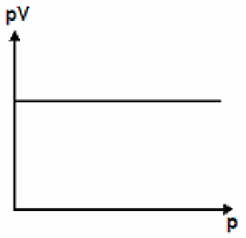
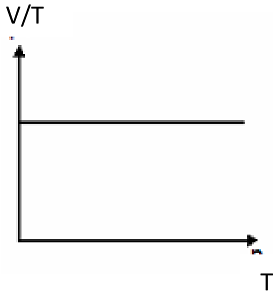
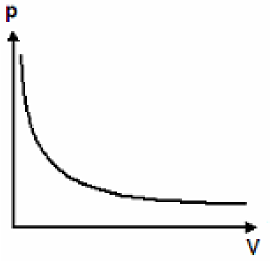
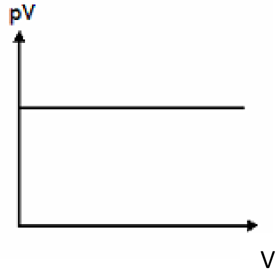
1.	A solid hydrocarbon was completely combusted in a closed vessel at 120 ^oC. The residual gas had a volume of 64 cm^3, which decreased by 24 cm^3 after bubbling through a dehydrating agent. After this, 40% of the final gas volume consisted of oxygen. What is the empirical formula of the hydrocarbon?	
	A	CH
	B	CH_2
	C	CH_3
	D	C_2H_3
		Vol of H_2O = 24 cm^3 Vol of CO_2 = 0.6 x (64 – 24) = 24 cm^3 Mole ratio of CO_2 : H_2O = 24 : 24 = 1 : 1 Mole ratio of C : H in C_xH_y = 1 : 2

2.	When cobalt metal is reacted with a solution containing cobalt(III) ions, cobalt(II) ions are formed. How many moles of Co and Co^{3+}(aq) would result in a mixture containing both cobalt(II) and cobalt(III) ions in the mole ratio of 3:1 after the reaction had taken place?		
		Moles of Co	Moles of Co^{3+}
	A	1	2
	B	1	3
	C	1	5
	D	2	3
		$Co + 2Co^{3+} \rightarrow 3Co^{2+}$ I 1 3 0 (Co^{3+} was in excess) C -1 -2 +3 F 0 1 3	

3.	Which graph does not share the same general shape with the other three graphs according to the ideal gas law for a fixed mass of gas?	
	A	pV against p (at constant T) pV = nRT At constant T, pV = constant 
	B	V/T against T (at constant p) pV = nRT At constant p, $V = (\frac{nR}{p})T$ $\frac{V}{T} = \frac{nR}{p}$ = constant 
	C	p against V (at constant T) pV = nRT At constant T, $p = (nRT)\frac{1}{V}$ 
	D	pV against V (at constant T) pV = nRT At constant T, $pV = nRT = constant$ 

4.	Which element will possess an empty s orbital after forming a singly-charged cation?	
	A	Barium Ba^+: $[Xe]6s^1$
	B	Vanadium V^+: $[Ar]3d^3 4s^1$
	C	Copper Cu^+: $[Ar]3d^{10}$
	D	Gallium Ga^+: $[Ar]4s^2$

5.	Which of the following reactions will form a product with the same shape as the reactant with respect to the underlined element?	
	A	$\underline{2Al}Cl_3 \rightarrow \underline{Al_2}Cl_6$ Trigonal planar to Tetrahedral
	B	$2H_2\underline{O_2} \rightarrow 2H_2O + \underline{O}_2$ Bent to Linear
	C	$\underline{P}Cl_3 + Cl_2 \rightarrow \underline{P}Cl_5$ Trigonal pyramidal to Trigonal bipyramidal
	D	$CH_3CH_2\underline{C}HO + [O] \rightarrow CH_3CH_2\underline{C}OOH$ Trigonal planar to Trigonal planar

6.	Which of the following is arranged correctly in the order of decreasing melting points?	
	A	Sulfur > Chlorine > Argon S_8 has the largest electron cloud, followed by Cl_2 and Ar, hence it has the most extentive id-id interactions.
	B	Carbon dioxide > Silicon dioxide > Germanium dioxide Silicon dioxide (giant covalent structure) should have a higher m.p than carbon dioxide (simple covalent structure).
	C	Beryllium chloride > Magnesium chloride > Calcium chloride Beryllium chloride (simple covalent structure due to high charge density of Be^{2+}) should have a lower m.p than magnesium chloride.
	D	Sodium > Magnesium > Aluminium Al has the largest no. of delocalised electrons, followed by Mg and Na, hence it has the strongest metallic bonding.

7. A student dissolved 0.238 mol of sodium fluoride in 300 cm^3 of water.

Given the following data:

Lattice energy of NaF	−918 kJ mol^{-1}
Enthalpy change of hydration of F$^-$	−457 kJ mol^{-1}
Enthalpy change of hydration of Na$^+$	−390 kJ mol^{-1}

What would be the initial temperature of the water if the final temperature of the solution is 20.00^{o}C?

Assume that the specific heat capacity of sodium fluoride solution is 4.18 J g^{-1} K^{-1}.

A 6.52^{o}C

B 13.48^{o}C

C 20.00^{o}C

D 33.48^{o}C

$\Delta H_{sol} = \Delta H_{hyd} - L.E =$ – 457 – 390 – (–918) = +71 kJ mol^{-1} (endothermic)

Heat absorbed, q = 71 x 0.238 = 16.898 kJ

$\Delta T = -\frac{q}{mc} = -\frac{16898}{300\ (4.18)} = -13.48^{o}C$

Initial T = 20 + 13.48 = 33.48^{o}C

8. Ammonia gas and hydrogen chloride gas react to form ammonium chloride as shown in the equation below:

$$NH_3\,(g) \;+\; HCl\,(g) \;\rightarrow\; NH_4Cl\,(s) \qquad \Delta H^{\ominus} = -176 \text{ kJ mol}^{-1}$$

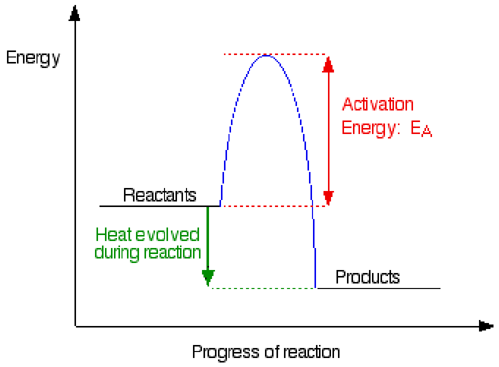
The standard entropy change of this reaction is -284 J K^{-1} mol^{-1}.

Which of the following statements is **not** correct?

A At room temperature, $\Delta G^{\ominus} = +84.4$ kJ mol^{-1}.

$\Delta G^{\ominus} = \Delta H^{\ominus} - T\Delta S^{\ominus} = -176 - 298(-0.284) = -91.4$ kJ mol^{-1}

B The reactants are less stable than the product.



C The reaction is spontaneous at low temperatures and non-spontaneous at high temperatures.

At low T, $|\Delta H| > |T\Delta S|$, since both ΔH and ΔS are negative, $\Delta G < 0$.

D There is a decrease in the degree of disorderliness.

There is a decrease in no. of gaseous moles from 2 to 0.

9. The following experimental results are obtained for a reaction with the general rate equation of:

$$\text{rate} = k\,[\mathbf{M}]^{x}\,[\mathbf{N}]^{y}\,[\mathbf{L}]$$

Experiment	**[M] / mol dm^{-3}**	**[N] / mol dm^{-3}**	**[L] / mol dm^{-3}**	**Relative rate**
1	0.1	0.2	0.3	1
2	0.2	0.6	1.2	72

Which of the following are possible values of x and y?

	x	y
A	1	1
B	2	1
C	1	2
D	2	2

From expt 1 to 2, [M] increases by 2 times, [N] increases by 3 times and [L] increases by 4 times, rate increases by 72 times. Order of reaction wrt [L] is 1.

A: $2^1 \times 3^1 \times 4^1 = 24$

B: $2^2 \times 3^1 \times 4^1 = 48$

C: $2^1 \times 3^2 \times 4^1 = 72$

D: $2^2 \times 3^2 \times 4^1 = 144$

10.	Which of the following will decrease the rate constant for a reaction?	
	A	Decrease in concentration
	B	Decrease in temperature
	C	Decrease in pressure
	D	Addition of catalyst

From Kinetics lecture notes,

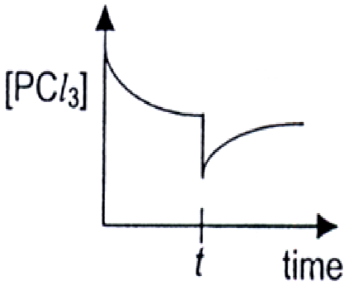
Change	***Effect on rate constant, k***	***Effect on E_A***
Increase in concentration	*No effect*	*No effect*
Increase in pressure (gaseous system)	*No effect*	*No effect*
Increase in temperature	*Increased*	*No effect*
Use of catalyst	*Increased*	*Decreased*

11. Phosphorus trichloride and chlorine react according to the following equation:

$$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$$

A mixture of PCl_3 and Cl_2 was placed in a syringe and brought to equilibrium at time *t* and the following graph was obtained.

Which of the following accounts for the drop in $[PCl_3]$ at time *t*?



A	PCl_5 was added to the mixture
B	Argon gas was added to the mixture
C	The syringe was heated
D	The plunger of the syringe was withdrawn until the volume was twice the initial volume Volume increases, resulting in an immediate drop in pressure. Equilibrium then shifts left to increase the pressure by favouring the backward reaction which produces less gaseous molecules.

12. Which of the following statements about phosphoric(V) acid is **not** correct?

A	HPO_4^{2-} has a higher K_b value than $H_2PO_4^-$. K_a of H_3PO_4 > K_a of $H_2PO_4^-$ > K_a of HPO_4^{2-} K_b of $H_2PO_4^-$ < K_b of HPO_4^{2-} since $K_b = K_w / K_a$
B	PO_4^{3-} can react as a base. In presence of acid, $PO_4^{3-} + H^+ \rightarrow HPO_4^{2-}$
C	$H_2PO_4^-$ can react both as an acid and as a base. In presence of acid, $H_2PO_4^- + H^+ \rightarrow H_3PO_4$ In presence of base, $H_2PO_4^- + OH^- \rightarrow HPO_4^{2-} + H_2O$
D	H_3PO_4 has a higher pK_a than HPO_4^{2-}. K_a of H_3PO_4 > K_a of $H_2PO_4^-$ > K_a of HPO_4^{2-} pK_a of H_3PO_4 < pK_a of $H_2PO_4^-$ < pK_a of HPO_4^{2-}

[Turn Over

13.	95 cm^3 of M^{2+} ions is mixed with an an equal volume of X^- ions at 25°C. Which of the following initial concentrations of M^{2+} and X^- will result in the precipitation of MX_2? (K_{sp} of MX_2 = 7.67×10^{-13} mol^3 dm^{-9})		
		$[M^{2+}]$ / 10^{-4} mol dm^{-3}	$[X^-]$ / 10^{-4} mol dm^{-3}
	A	1	1
		I.P = $[M^{2+}][X^-] = (0.5 \times 10^{-4})(0.5 \times 10^{-4})^2 = 1.25 \times 10^{-13}$ mol^3 dm^{-9} $< K_{sp}$	
	B	1	2
		I.P = $[M^{2+}][X^-] = (0.5 \times 10^{-4})(1 \times 10^{-4})^2 = 5 \times 10^{-13}$ mol^3 dm^{-9} $< K_{sp}$	
	C	2	1
		I.P = $[M^{2+}][X^-] = (1 \times 10^{-4})(0.5 \times 10^{-4})^2 = 2.5 \times 10^{-12}$ mol^3 dm^{-9} $< K_{sp}$	
	D	2	2
		I.P = $[M^{2+}][X^-] = (1 \times 10^{-4})(1 \times 10^{-4})^2 = 1 \times 10^{-12}$ mol^3 dm^{-9} $> K_{sp}$ Precipitation occurs	

14.	*Use of the Data Booklet is relevant to this question*. Glucose can be reacted with silver ions to form a silver mirror in the following reaction. $C_6H_{12}O_6 + 2Ag^+ + H_2O \rightarrow 2Ag + C_6H_{12}O_7 + 2H^+$ $E^\ominus_{cell} = +0.75$ V Which of the following metal ions **cannot** be used for a possible reaction with glucose?	
	A	Mn^{3+} $Mn^{3+} + e^- \rightleftharpoons Mn^{2+}$ $E^\ominus = +1.49$ V
	B	V^{3+} $V^{3+} + e^- \rightleftharpoons V^{2+}$ $E^\ominus = -0.26$ V
	C	Fe^{3+} $Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$ $E^\ominus = +0.77$ V
	D	Co^{3+} $Co^{3+} + e^- \rightleftharpoons Co^{2+}$ $E^\ominus = +1.82$ V
		Ag^+ is reduced to Ag while glucose is oxidised. $E^\ominus_{cell} = E^\ominus_{red} - E^\ominus_{ox} = +0.75$ V $E^\ominus_{ox} = 0.80 - 0.75$ V = + 0.05 V For a feasible reaction, $E^\ominus_{cell} < 0$, hence $E^\ominus_{red}$ (M^{x+}/M) should be more positive than +0.05 V.

15. *Use of the Data Booklet is relevant to this question*.

The following reaction does not occur under standard conditions.

$$2NO_3^{-}\,(aq) + 8H^{+}\,(aq) + 6Cl^{-}\,(aq) \rightleftharpoons 2NO\,(g) + 4H_2O\,(l) + 3Cl_2\,(g)$$

Which of the following can result in the reaction occuring?

A	Decreasing the volume of the reaction vessel
B	Addition of nitrogen monoxide
C	Decreasing the pH Increase in $[H^{+}]$ will cause equilibrium to shift right, favouring the forward reaction.
D	Addition of chlorine

16. The properties of the oxides of four Period 3 elements **W, X, Y** and **Z** are given below.

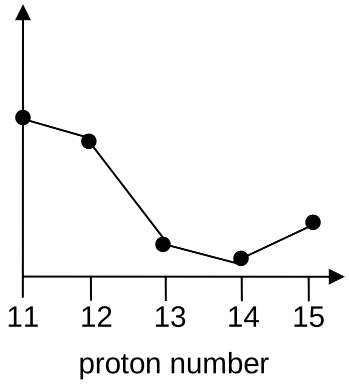
- The oxide of **W** is insoluble in water and in dilute acid but soluble in concentrated sodium hydroxide.
- The oxide of **X** is amphoteric.
- The oxide of **Y** reacts with dilute potassium hydroxide at room temperature.
- The oxide of **Z** dissolves in water to form a solution of pH = 13.

Which of the following is correct in order of increasing atomic number?

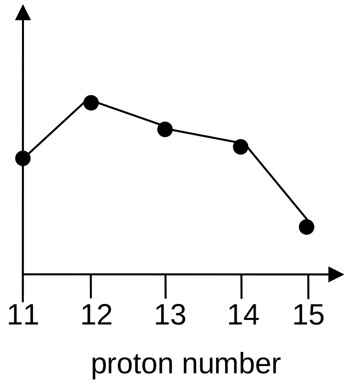
A	**Z, X, W, Y**	**C**	**Z, W, X, Y**
B	**W, X, Y, Z**	**D**	**Z, Y, W, X**

W is Silicon. X is Aluminium. Y is either Phosphorus or Sulfur. Z is Sodium.

17. The following graphs show how two properties of the elements, Na to P, and their compounds, vary with proton number.



Graph 1



Graph 2

What properties are shown by the two graphs?

	Graph 1	Graph 2
A	Melting point of oxide	Conductivity of element
B	Melting point of oxide	Melting point of chloride
C	Melting point of chloride $NaCl$ & $MgCl_2$ – giant ionic $AlCl_3$, $SiCl_4$ and PCl_5 – simple covalent	Melting point of oxide NaO, MgO & Al_2O_3 – giant ionic Si_2O_3 – giant covalent P_4O_{10} – simple covalent
D	Melting point of element	Conductivity of element

[Turn Over

18. A student observed the reactions when sodium chloride was added separately to concentrated sulfuric acid and concentrated phosphoric acid. The experiment was repeated using sodium iodide.

Reagent	**Observation with sodium chloride**	**Observation with sodium iodide**
conc. H_2SO_4	white fumes evolved	purple vapour evolved
conc. H_3PO_4	white fumes evolved	white fumes evolved

Which deduction can be made from these observations?

A The reducing power of HI is greater than that of HC*l*.

$NaCl + H_2SO_4 \rightarrow HCl$ (white fumes) $+ NaHSO_4$ (*Cl^- is not oxidised at all.*)

$NaI + H_2SO_4 \rightarrow HI + NaHSO_4$

HI produced is readily oxidised by conc. H_2SO_4 to I_2, hence I^- has a greater ease of oxidation and reducing power than Cl^-.

$8HI + H_2SO_4 \rightarrow 4I_2 + H_2S + 4H_2O$

B The bond length of HI is smaller than that of HC*l*.

False, as HC*l* has higher bond strength (smaller bond length) than HI due to smaller size of C*l* and more effective orbital overlap.

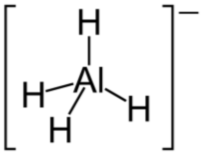
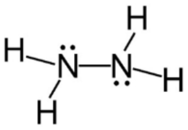
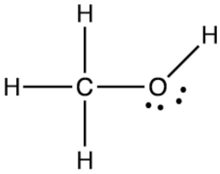
C Concentrated phosphoric acid is a stronger oxidising agent than concentrated sulfuric acid.

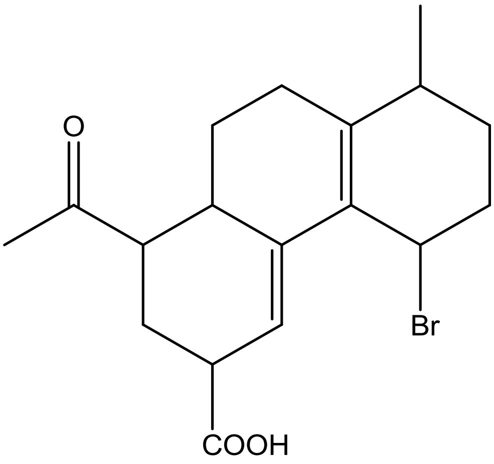
H_3PO_4 is a non-oxidising acid.

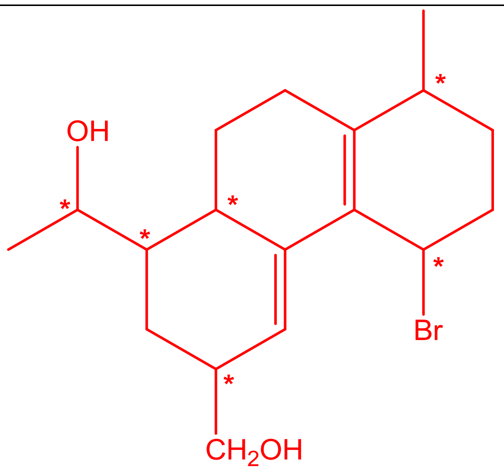
D Basicity of concentrated phosphoric acid is greater than concentrated sulfuric acid.

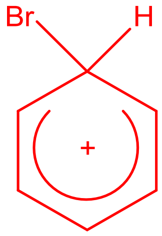
True, but cannot be deduced from the above observations.

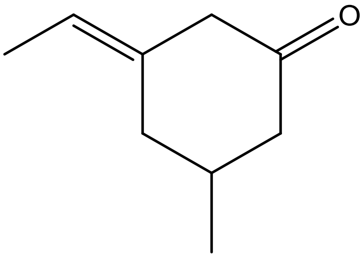
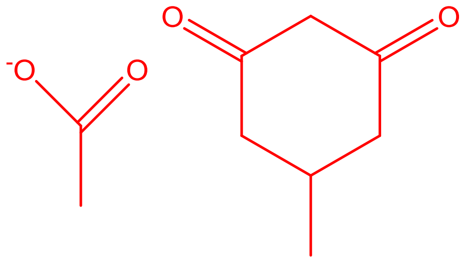
19.	The following data refer to cobalt as a typical transition element and calcium as an s-block element. Which of the following properties shows the correct data for both elements?			
		Property	**Cobalt**	**Calcium**
	A	Metallic radius / nm	0.150	0.117
		Co has more protons than Ca, hence the nuclear charge is higher than Ca. Co also has more electrons than Ca but the increase in shielding effect is minimal. Although the additional 2 electrons in Co are added in an inner sub-shell, they still provide a relatively poor shielding for the outermost 4s electrons. Hence, the valence 4s electrons in Co experiences a greater effective nuclear charge and are attracted more strongly to the nucleus than those in Ca, resulting in a smaller radius.		
	B	Electrical conductivity / relative units	10.1	50
		Cobalt should have higher conductivity than calcium due to more delocalised electrons from 3d and 4s.		
	C	Melting point / °C	1495	1965
		Cobalt should have higher m.p than calcium. For cobalt, both 3d and 4s electrons are delocalised to form a 'sea' of electrons for strong metallic bonding. Hence, strong electrostatic forces holding the metallic cations (which has a larger cationic charge and smaller cationic radius) together.		
	D	Density / g cm^{-3}	8.9	1.54
		While the size of the atom, measured by the metallic radius, decreases slightly from scandium to zinc, the relative atomic mass increases considerably. This results in an increase in density from scandium to zinc. The d-block metals are, in general, denser than the s-block metals.		

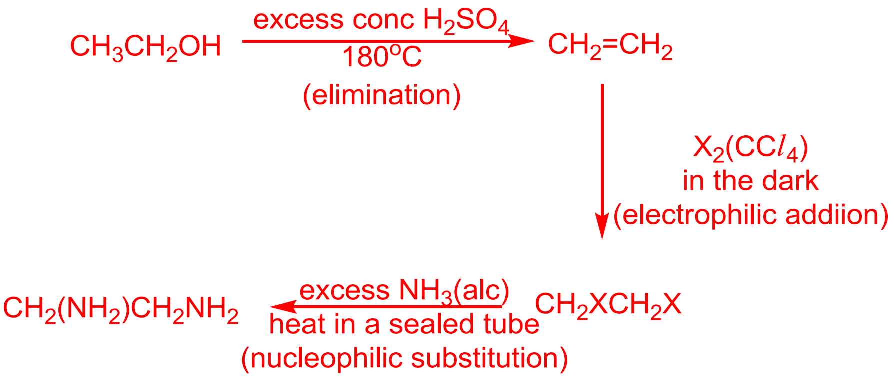
20.	Which of the following cannot act as a ligand?		
	A	AlH_4^-	 No available lone pair for dative bonding
	B	N_2H_4	
	C	CH_3OH	
	D	CO	

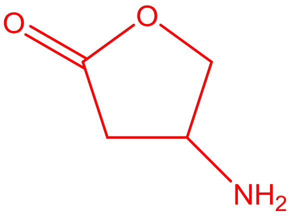
21.	The following compound is reacted with $LiAlH_4$ in dry ether.  What is the number of stereoisomers the product would possess?	
	A	2^6
	B	2^7
	C	2^8
	D	2^9

	 is the product, with no geometric isomers

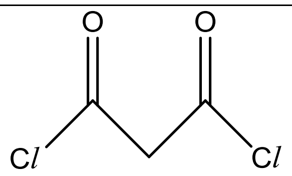
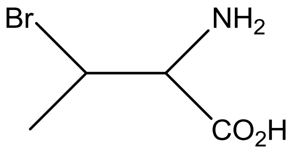
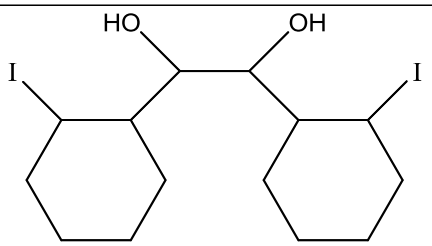
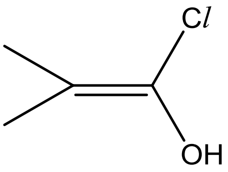
22.	Which statement with regards to the reaction of monobromination of benzene is correct?	
	A	This is considered a nucleophilic substitution reaction.
		This should be electrophilic substitution
	B	The intermediate consists of 4 pi electrons.
		
	C	The intermediate is planar.
		The carbon with four bonds has a tetrahedral shape
	D	Upon addition of ethanolic silver nitrate solution to bromobenzene, a cream precipitate would be observed.
		Bromine is directly bonded to the benzene and hence would not likely undergo nucleophilic substitution to form Br^-. Hence no precipitation would occur.

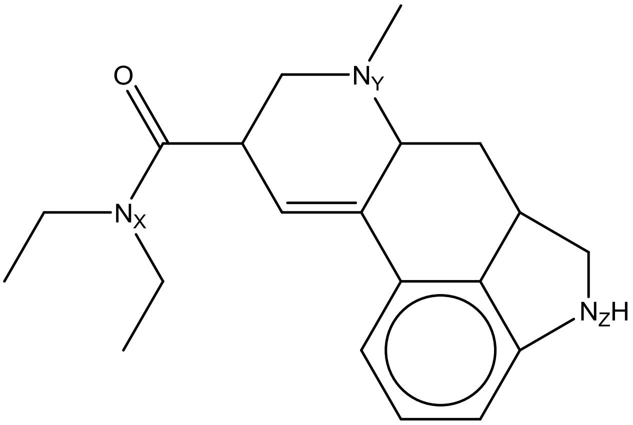
23.	The compound below was reacted with hot alkaline potassium manganate(VII) solution.  Which statement is correct?	
	A	The organic products consist of a total of 2 sp^2 hybridised carbons.
		There is a total of 3 sp^2 hybridised carbons.
	B	There are 3 chiral centres in the organic products.
		There are no chiral centres in the products.
	C	The organic products would not form a yellow precipitate with warm alkaline iodine solution.
	D	The organic products would not form an orange precipitate with 2,4–DNPH.
		There are 2 ketone functional groups in the products which would form an orange precipitate with 2,4-DNPH.
		 organic products of compound **A**

24.	In the following synthesis route, which reaction mechanism is **not** used? $CH_3CH_2OH \rightarrow CH_2{=}CH_2 \rightarrow CH_2XCH_2X \rightarrow CH_2(NH_2)CH_2NH_2$	
	A	electrophilic addition
	B	elimination
	C	nucleophilic substitution
	D	reduction
		

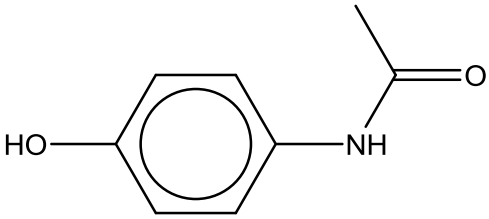
25.	A cyclic organic compound has the molecular formula $C_4H_7NO_2$. Which pair of the functional groups can be present in this molecule?	
	A	one ester group and one primary amine group
	B	one ester group and one nitrile group
	C	one primary alcohol group and one primary amide group
	D	one tertiary alcohol group and one tertiary amine group
		 **A**

26.	Which statement about ethanoic acid and its derivatives is correct?	
	A	Ethanamide is soluble in water to form a neutral solution due to the formation of equal proportions of ethanoic acid and ammonia.
		Ethanamide is soluble in water and remains as ethanamide molecules.
	B	Ethanoic acid has a relative molecular mass of 120 in liquid hexane.
		Ethanoic acid exist as a dimer in non-polar solvents.
	C	Ethanoyl bromide hydrolyses in water to produce reddish brown fumes.
		HBr are white fumes.
	D	Ethyl ethanoate, upon reaction with 2,4-DNPH, gives an orange precipitate.
		Esters do not undergo condensation reactions with 2,4-DNPH.

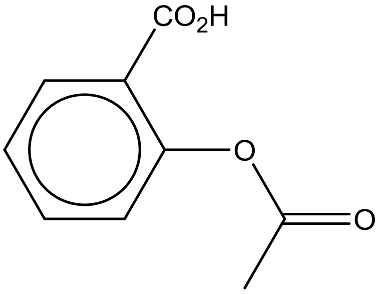
27.	Which compound would show the greatest ease of hydrolysis?			
	A		**B**	
	C		**D**	
		A – presence of ethanoyl chloride (an acyl chloride) which hydrolyses in water immediately **B** – alkyl bromide undergoes hydrolysis slower than acyl chlorides **C** – alkyl iodides undergoes hydrolysis faster than alkyl bromide due to the weaker C – I bond but still slower as compared to acyl chlorides. **D** – chlorine is directly bonded to carbon which is part of an alkene. This results in the C–C*l* bond possessing partial double bond character, hence hydrolysis is unlikely to take place.		

28.		
	 The compound above has a total of three nitrogen atoms (N_X, N_Y and N_Z). Which sequence show an increase in pOH?	
	A	N_X, N_Y, N_Z
	B	N_X, N_Z, N_Y
	C	N_Y, N_X, N_Z
	D	N_Y, N_Z, N_X
		N_X is the nitrogen in an amide, which is neutral. N_Y is the nitrogen in a tertiary amine. N_Z is the nitrogen in a N-substituted phenylamine, which has its electrons delocalised into the benzene ring.

29. Two common drugs administered when a patient experiences headache or fever are paracetamol and aspirin.

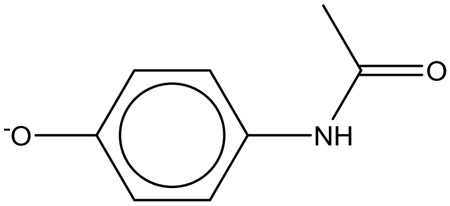
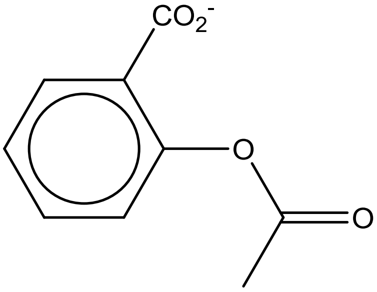
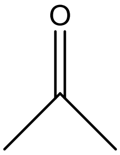
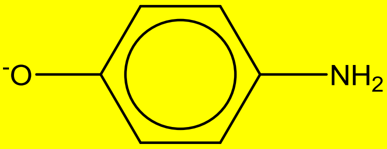


paracetamol

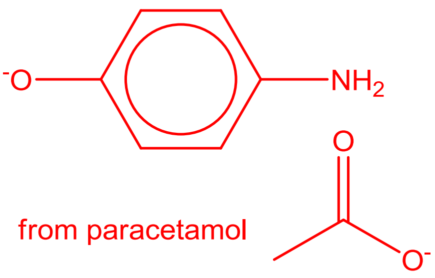


aspirin

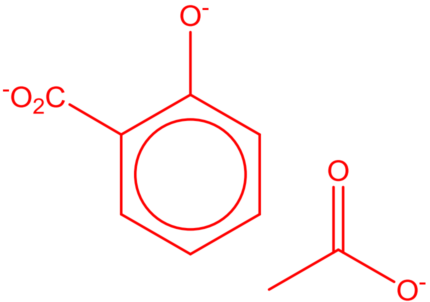
A solution of the two drugs was hydrolysed using hot aqueous sodium hydroxide. Which organic product would be produced?

A		**B**	
C		**D**	

The products are:



from paracetamol



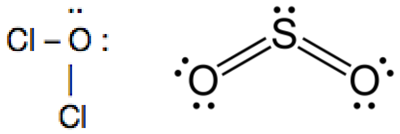
from aspirin

30.	Which statement about proteins and amino acids is **not** correct?	
	A	Amino acids exist as crystalline solids at room temperature.
		Amino acids exists as zwitterions which have strong ionic bonds and hence exist as crystalline solids at room temperature.
	B	Hydrogen bonds can be found in secondary and tertiary structures of proteins.
		Hydrogen bonds between peptide linkages form the secondary structure and hydrogen bonds between R-groups form the unique 3D conformation in the tertiary structure.
	C	Denaturation of proteins leads to the breaking down of the primary structure.
		Disruption of primary structure occurs during hydrolysis. Denaturation is the process where secondary, tertiary and quaternary structures are disrupted.
	D	Amino acids can act as buffer solutions.
		Amino acids, upon dissolving in water, would form zwitterion, which has both acidic and basic functional groups and hence could maintain the pH of the solution when small amounts of acid or alkali are added.

31.	Which of the following are disproportionation reactions?	
	1	$3Cl_2 + 6NaOH \rightarrow 5NaCl + NaClO_3 + 3H_2O$
	2	$IO_3^- + 5I^- + 6H^+ \rightarrow 3I_2 + 3H_2O$
	3	$15Se + SeCl_4 + 4AlCl_3 \rightarrow 2Se_8[AlCl_4]_2$
		Disproportionation reaction is a redox reaction in which a species is simultaneously reduced and oxidised to form two different products. The second and third reactions show two species in different oxidation states forming one product with another oxidation state.

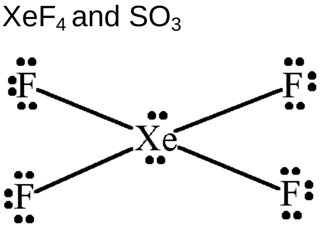
32. Which of the following pairs are both planar and polar?

1 OCl_2 and SO_2

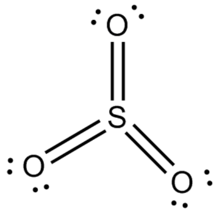


Both ben and non-polar

2 XeF_4 and SO_3

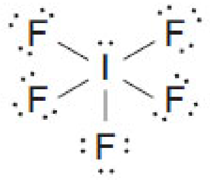


Square planar
Non-polar

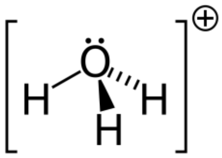


Trigonal planar
Non-polar

3 IF_5 and H_3O^+



Square pyramidal
Polar



Trigonal pyramidal
Polar

33. Which of the following increase with decreasing temperature for the dissociation of water?

Temperature/ °C	K_w/ mol^2 dm^{-6}
50	5.5×10^{-14}
25	1.0×10^{-14}

1 pK_b

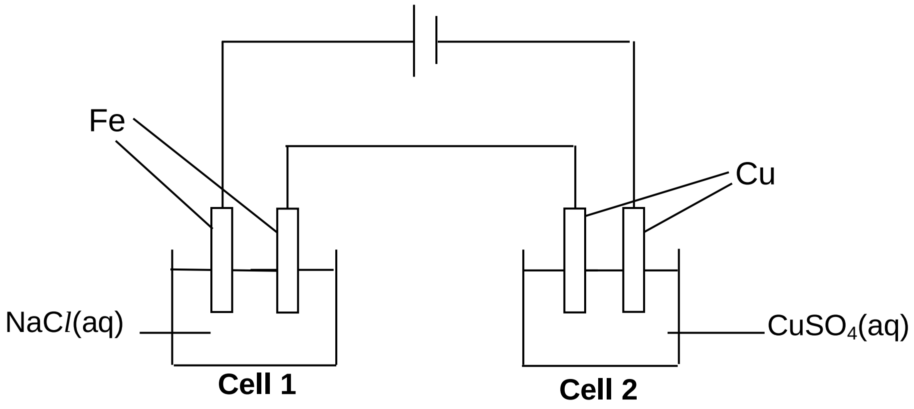
At lower T, K_w ↓, [OH$^-$] ↓, K_b ↓, pK_b ↑

2 pH

At lower T, K_w ↓, [H$^+$] ↓, pH ↑

3 pK_w

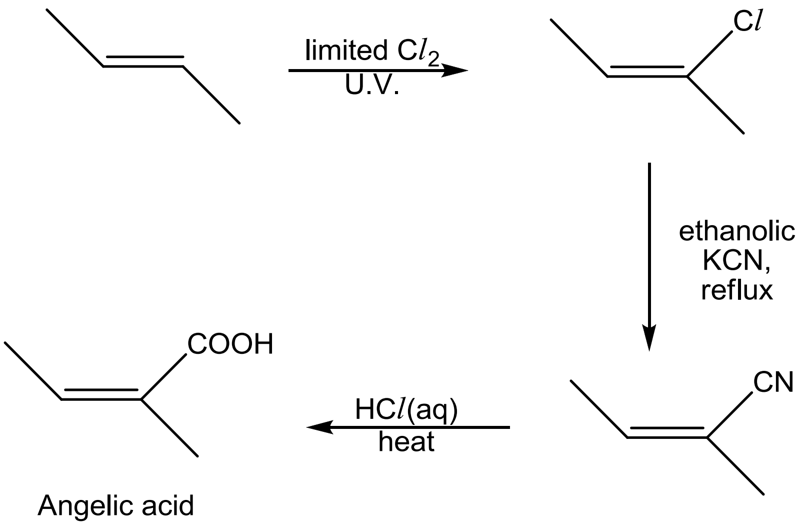
At lower T, K_w ↓, pK_w ↑

34.	*Use of the Data Booklet is relevant to this question*. Which of the following statements can be deduced from the diagram below? 
1	Size of the anode in **Cell 1** decreases. At the anode: $Cl_2 + 2e^- \rightleftharpoons 2Cl^-$ $E^\ominus = +1.36$ V $O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O$ $E^\ominus = +1.23$ V $Fe^{2+} + 2e^- \rightleftharpoons Fe$ $E^\ominus = -0.44$ V $Fe^{3+} + 3e^- \rightleftharpoons Fe$ $E^\ominus = -0.04$ V Fe has the most negative $E^\ominus$, so it will get oxidised at the anode.
2	Colour of the electrolyte in **Cell 2** remains the same. Electroplating of copper in Cell 2. Anode: $Cu \rightarrow Cu^{2+} + 2e^-$ Cathode: $Cu^{2+} + 2e^- \rightarrow Cu$
3	Effervescence is observed in both cells immediately.

35.	0.5 mol of each of the following was added to 100 cm^3 of water. Which of the following solutions are arranged correctly in the order of increasing pH?	
	1	$SiCl_4$, $MgCl_2$, $NaCl$ $SiCl_4$ (pH = 2 due to HCl fumes), $MgCl_2$ (pH = 6.5 due to high polarising power of Mg^{2+}), $NaCl$ (pH = 7)
	2	H_2SO_4, HNO_3, CH_3CH_2COOH H_2SO_4 (strong dibasic acid), HNO_3 (strong monobasic acid), CH_3CH_2COOH (weak organic acid)
	3	NH_3, CH_3NH_2, KOH CH_3NH_2 is more basic than NH_3 due to the electron-donating methyl group which increases the availability of the lone pair of e^- on N. KOH is a strong base.

36.	*Use of the Data Booklet is relevant to this question*. When iron filings are added to nitric acid, a yellow solution and nitrogen dioxide gas are formed. On the addition of ammonium thiocyanate to the resultant solution, a blood-red colouration due to an iron (III) complex is formed. Which statements are correct?	
	1	The oxidation state of N decreases from +6 to +4 in the first reaction. It should be from +5 to +4.
	2	Redox and ligand exchange have taken place. Redox: Fe is oxidised to Fe^{3+} and NO_3^- is reduced to NO_2. Ligand exchange: $\underset{\text{yellow}}{[Fe(H_2O)_6]^{3+}} + SCN^- \rightarrow \underset{\text{blood-red}}{[Fe(SCN)(H_2O)_5]^{2+}} + H_2O$
	3	The standard cell potential of the reaction between iron filings and nitric acid is +0.85 V. $Fe^{3+} + 3e^- \rightleftharpoons Fe$ $E^\ominus = -0.04$ V $NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2 + H_2O$ $E^\ominus = +0.81$ V $E^\ominus_{cell} = +0.81 - (-0.04) = +0.85$V

37. The following steps represent a student's attempt to synthesise angelic acid from but-2-ene.

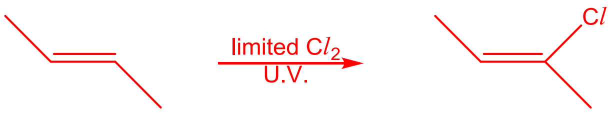


Angelic acid

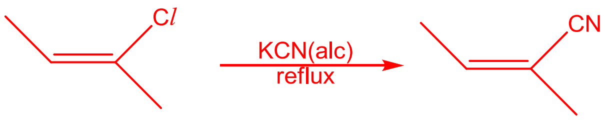
Unfortunately, he was unable to synthesise angelic acid. Which steps were incorrect?

1	$HCl(aq)$, heat
2	limited Cl_2, U.V.
3	Ethanolic KCN reflux

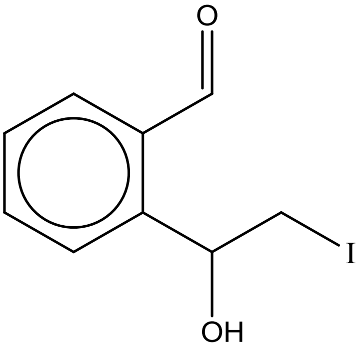
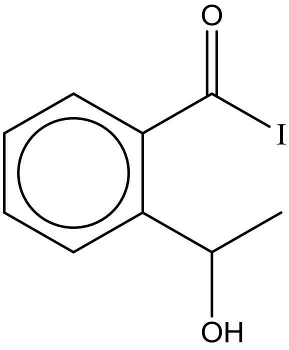
more likely to undergo

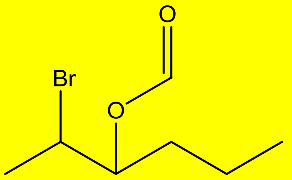
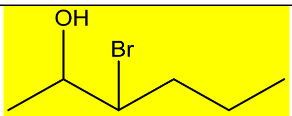
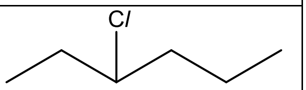
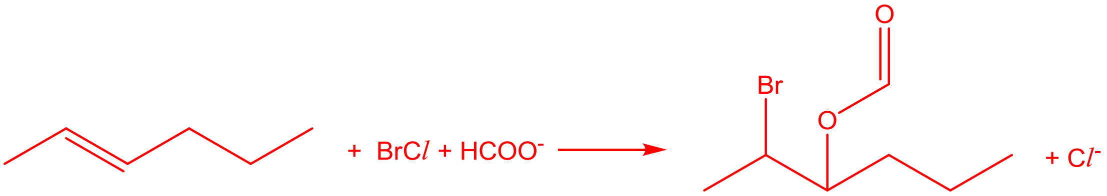
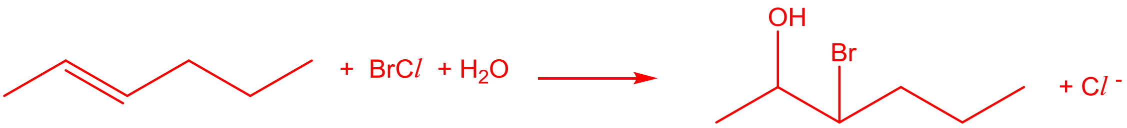
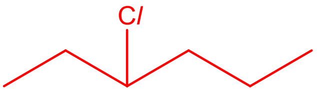


difficult to undergo monosubstitution only and more likely to substitute on the alkane hydrogens than the alkene hydrogens



unlikely to occur as carbon with Cl is electron rich

38.	 compound **A**  compound **B** Which of the following reagents would react with both compounds mentioned above?	
	1	warm alkaline iodine solution
	2	warm Fehling’s solution
	3	2,4–DNPH
		Neither compounds would work with Fehling’s solution as neither have the aliphatic aldehyde function group, compound **B** is an acyl iodide which is not a carbonyl compound and hence would not react with 2,4-DNPH.

39.	Hydrogen iodide reacts with liquid hex-2-ene to form 2-iodohexane and 3-iodohexane. When hex-2-ene is mixed with bromine monochloride, BrCl, dissolved in aqueous sodium methanoate, a similar reaction occurs. Which are the possible products in the mixture?					
	1		**2**		**3**	
	   not a possible product as the first element added should be Br.					

40.	Deuterium, D, is the $^{2}_{1}H$ isotope of hydrogen. Which reactions could give an organic compound having a chiral centre?	
	1	$CH_3CHO \xrightarrow{DCN,\ NaOH}$
		The product is made of optical isomers of $CH_3CH(OH)CO_2^-$
	2	$C(CH_3)_2{=}CH_2 \xrightarrow{DCl}$
		The product is made of $C(CH_3)_2ClCH_2D$
	3	$CH_3COCH_3 \xrightarrow{NaBD_4,\ CD_3OD}$
		The product is made of $CH_3CD(OD)CH_3$

~~~ END ~~~