



SERANGOON JUNIOR COLLEGE
General Certificate of Education Advanced Level
Higher 1

Candidate Name

Class

CHEMISTRY

JC2 Preliminary Examination
Paper 1 Multiple Choice

8872/01

22 Sept 2017 (AM)
50 min

Additional Materials: Data Booklet
 Optical Mark Sheet (OMS)

READ THESE INSTRUCTIONS FIRST

On the separate multiple choice OMS given, write your name, subject title and class in the spaces provided.

Shade correctly your FIN/NRIC number.

There are **30** questions in this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the one you consider correct and record your choice using a **soft pencil** on the separate OMS.

You are advised to fill in the OMS as you go along; no additional time will be given for the transfer of answers once the examination has ended.

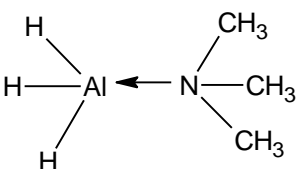
Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this question paper.

The use of an approved scientific calculator is expected, where appropriate.

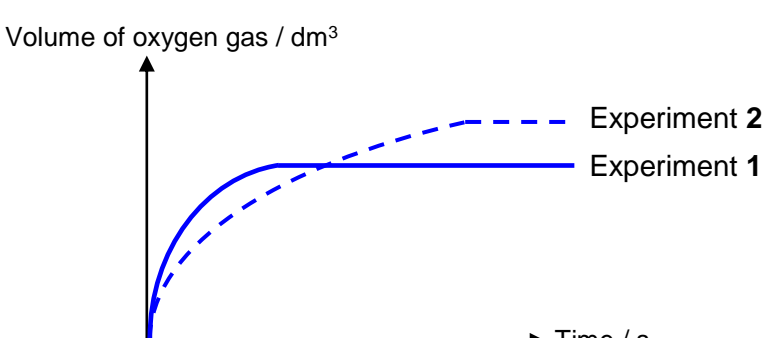
Section A

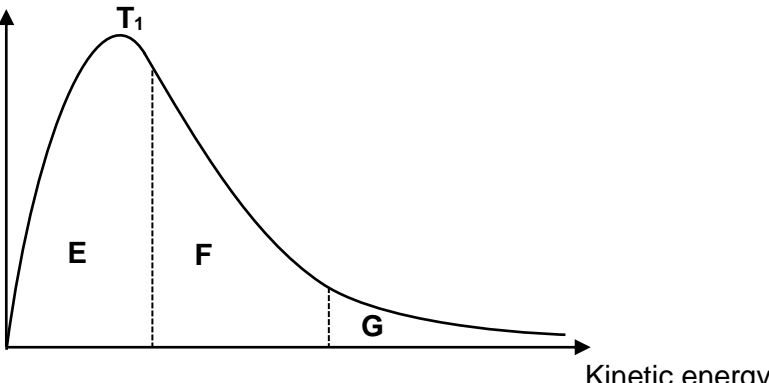
For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the one you consider to be correct.

1	In a titration, a 30.0 cm ³ sample of 0.05 mol dm ⁻³ of the phosphoric acid, H ₃ PO ₄ , was found to require 15.00 cm ³ of 11.22 g dm ⁻³ solution of potassium hydroxide to reach the endpoint. Which of the following is the salt formed from the reaction?			
	A	KH ₂ PO ₄		
	B	K ₂ HPO ₄		
	C	K ₃ PO ₄		
	D	KPO ₃		
	<p>Answer: B</p> $n_{\text{H}_3\text{PO}_4} = \frac{30}{100} \times 0.05 = 0.0015 \text{ mol}$ $n_{\text{KOH}} = \frac{11.22}{56.1} \times \frac{15}{1000} = 0.003 \text{ mol}$ <p>0.0015 H₃PO₄ \equiv 0.003 KOH H₃PO₄ \equiv 2 KOH</p> <p>\therefore K₂HPO₄ is formed.</p>			
2	Which species are oxidised and reduced in the following reaction?			
	$\text{IO}_3^- + 2\text{I}^- + 6\text{H}^+ + 6\text{Cl}^- \rightarrow 3\text{ICl}_2^- + 3\text{H}_2\text{O}$			
		species oxidised	species reduced	
	A	IO ₃ ⁻	I ⁻	
	B	I ⁻ , IO ₃ ⁻	Cl ⁻	
	C	I ⁻	IO ₃ ⁻	
	D	H ⁺ , Cl ⁻	IO ₃ ⁻	
	<p>Answer: C</p> $\begin{array}{ccccccccccc} \text{IO}_3^- & + & 2\text{I}^- & + & 6\text{H}^+ & + & 6\text{Cl}^- & \rightarrow & 3\text{ICl}_2^- & + & 3\text{H}_2\text{O} \\ +5 & & -1 & & +1 & & -1 & & +1 & -1 & +1 \end{array}$			

3	How many unpaired electrons are present in S and S ²⁻ respectively?			
		S	S ²⁻	
	A	1	0	
	B	1	2	
	C	2	0	
	D	2	2	
<p>Answer: C</p> <p>$_{16}\text{S} : 1s^2 2s^2 2p^6 3s^2 3p^4$ (2 unpaired electron)</p> <p>$_{16}\text{S}^{2-} : 1s^2 2s^2 2p^6 3s^2 3p^6$ (0 unpaired electrons)</p>				
4	Which statement about (CH ₃) ₃ NA/H ₃ is correct?			
	A	It exist as a dimer.		
	B	It contains hydrogen bonding.		
	C	The Al atom is electron deficient.		
	D	The bonds around the Al atom are tetrahedrally arranged.		
<p>Answer: D</p> <div></div> <p>Al has energetically accessible orbitals to accept the lone pair of electrons form N. There are four bond pairs about Al. The shape about Al is tetrahedral.</p>				
5	In which substance must covalent bonds break on melting?			
	A	Phosphorus(V) chloride		
	B	Beryllium chloride		
	C	Silicon carbide		
	D	Iron(II) hydroxide		
<p>Answer: C</p> <p>A and B are simple molecular compounds. C has a giant molecular structure and thus</p>				

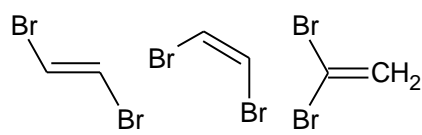
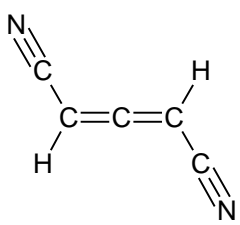
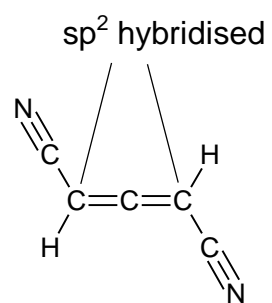
	covalent bonds are broken during boiling. D has a giant ionic lattice structure.		
6	Which of the following elements has an oxide with a giant structure and a chloride which is readily hydrolysed?		
	A	Silicon	
	B	Sodium	
	C	Carbon	
	D	Phosphorus	
	Answer: A SiO_2 is a giant molecular compound. SiCl_4 is readily hydrolysed in water to form HCl . $\text{SiCl}_4(l) + 2\text{H}_2\text{O}(l) \rightarrow \text{SiO}_2(s) + 4\text{HCl}(aq)$		
7	Archaeologists used ^{14}C , a radioactive isotope, in carbon dating. An artefact is analysed and its ^{14}C content is measured to be 20% of the typical initial amount of ^{14}C in trees. Given that the radioactive decay of ^{14}C has a half-life of 5500 years, what is the approximate age of this artefact?		
	A	1.10×10^4 years	C 1.38×10^4 years
	B	1.28×10^4 years	D 1.65×10^4 years
	Answer: B $\frac{C}{C_0} = \left(\frac{1}{2}\right)^n$ $\frac{20}{100} = \left(\frac{1}{2}\right)^n$ $n = 2.32$ $t_{1/2} = 2.32 \times 5500 = 1.28 \times 10^4 \text{ years}$		

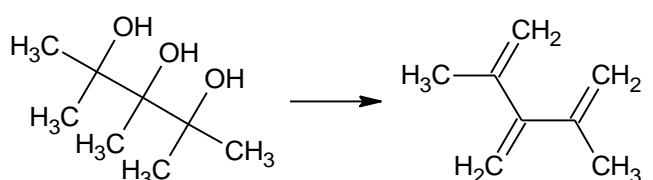
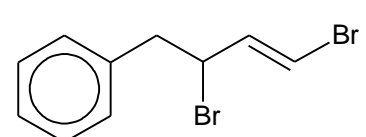
8	<p>Experiments were carried out to investigate the rates of decomposition of 100 cm³ of 1.0 mol dm⁻³ hydrogen peroxide, catalysed by manganese (IV) oxide.</p> $\text{H}_2\text{O}_2 (\text{aq}) \longrightarrow \text{H}_2\text{O} (\text{l}) + \frac{1}{2} \text{O}_2 (\text{g})$ <p>The volume of oxygen gas collected using a gas syringe was monitored. The results are shown in the diagram below.</p>  <p>Which of the following alteration to the experimental conditions in Experiment 1 would produce the curve observed in Experiment 2?</p>
A	Lowering the temperature.
B	Decreasing the amount of MnO ₂ used.
C	Diluting the hydrogen peroxide solution with water.
D	Adding 100 cm ³ of 0.1 mol dm ⁻³ hydrogen peroxide.
	<p>Answer: D</p> <p>Lowering the temperature and decreasing the amount of MnO₂ will slow down the rate of reaction (less steep curve) but will not change the volume of oxygen produced.</p> <p>Diluting hydrogen peroxide solution with water will slow down the rate of reaction (less steep curve) and decrease the volume of oxygen produced.</p> <p>Adding some 0.1 mol dm⁻³ hydrogen peroxide will lower the concentration of hydrogen peroxide which leads to slower rate of reaction (less steep curve). As there are moles of hydrogen peroxide in the vessel, it will lead to more oxygen gas being produced.</p>

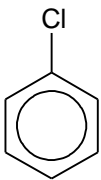
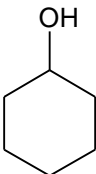
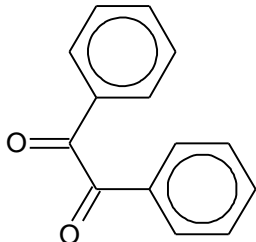
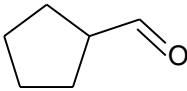
9	<p>The Maxwell Boltzman distribution curve shows the number of molecules having a given amount of kinetic energy at constant temperature, T_1.</p> <p>Number of molecules having a given amount of energy</p>  <p>Kinetic energy</p> <p>How would the size of the areas labelled E, F and G change if a lower temperature, T_2 was used?</p>			
		E	F	G
A		Increase	Increase	Decrease
B		Increase	Decrease	Decrease
C		Decrease	Increase	Increase
D		Decrease	Decrease	Increase
<p>Answer: B</p> <p>At a lower temperature T_2, the graph will shift to the left hand side and the peak of the graph will be higher than the original. Since there is no change to the number of molecules, the area under both graphs (T_1 and T_2) should be the same.</p> <p>At a lower temperature, the number of molecules of lower kinetics energy will increase thus the area of E will increase. Also, there will be less molecules of higher kinetics energy thus area F and G will decrease.</p>				

10	The diagram represents the energy changes for some reactions. <div style="text-align: center;">$\begin{array}{ccc} W & \xrightarrow{\Delta H = -130 \text{ kJ mol}^{-1}} & X \\ & & \downarrow \Delta H = +80 \text{ kJ mol}^{-1} \\ Y & \xrightarrow{\Delta H = -25 \text{ kJ mol}^{-1}} & Z \end{array}$</div> <p>What are the natures of the conversions W → Y, Y → X and Z→W?</p>			
		W → Y	Y → X	Z → W
A		Exothermic	Endothermic	Endothermic
B		Exothermic	Exothermic	Endothermic
C		Endothermic	Exothermic	Exothermic
D		Endothermic	Endothermic	Exothermic
	<p>Answer: B</p> <p>$W \rightarrow Y : \Delta H = -130 + 80 - (-25) = -25 \text{ kJ mol}^{-1}$</p> <p>$Y \rightarrow X : \Delta H = -25 - 80 = -105 \text{ kJ mol}^{-1}$</p> <p>$Z \rightarrow W: -80 + 130 = +50 \text{ kJ mol}^{-1}$</p>			
11	Consider the following equilibrium system: <div style="text-align: center;">$2\text{AlCl}_3(\text{g}) \rightleftharpoons \text{Al}_2\text{Cl}_6(\text{g})$</div> <p>Which of the following statements will cause the position of the equilibrium to shift to the left?</p>			
A	Increasing the temperature			
B	Pumping AlCl_3 gas into the vessel			
C	Decreasing the volume of the vessel			
D	Adding a solid catalyst into the vessel			
	<p>Answer: A</p> <p>This reaction involves bond formation between 2 monomers of AlCl_3 to form the dimer</p>			

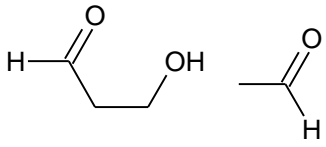
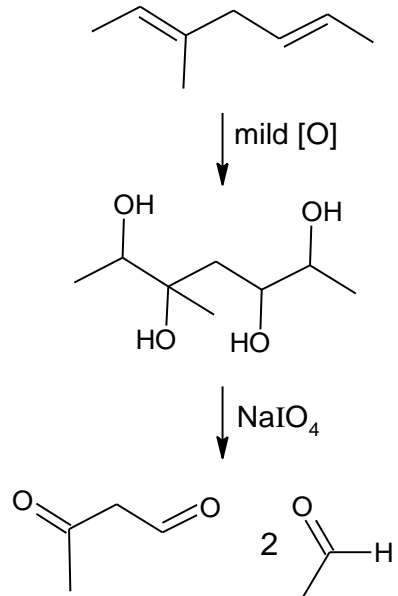
	<p>Al_2Cl_6 hence forward reaction is exothermic. By Le Chatelier's Principle, increasing the temperature will shift position of equilibrium to the left to favour endothermic reaction to absorb the excess heat.</p> <p>Adding AlCl_3 gas into the vessel will shift position of equilibrium to the right to use up the excess AlCl_3 gas.</p> <p>Decreasing the volume of the vessel will increase the partial pressure of both gases. By LCP, the position of equilibrium will shift to the right to produce lesser moles of gas.</p> <p>Adding a catalyst has no effect on the position of equilibrium. It will just lower the E_a and speed up both forward and backward reaction equally.</p>			
12	<p>Cyanidin (Cy) is a water-soluble plant pigment which can be found in blackberries. Blackberry juice is usually preserved by the addition of a small amount of $\text{SO}_2(\text{g})$ and the following equilibrium is set up:</p> $\text{CyH}^+(\text{aq}) + \text{SO}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{CySO}_3\text{H}_2(\text{aq}) + \text{H}^+(\text{aq})$ <p>What are the units for K_c?</p>			
	A	mol dm^{-3}	C	$\text{mol}^{-1} \text{dm}^3$
	B	$\text{mol dm}^{-3} \text{s}^{-1}$	D	no units
	<p>Answer: D</p> $K_c = \frac{[\text{CySO}_3\text{H}_2][\text{H}^+]}{[\text{CyH}^+][\text{SO}_2]} \quad \text{no units}$			
13	<p>A solution of an acid H has the same pH as a solution of acid J. Equal dilution increases the pH of acid H more than that of acid J. Which of the following pairs of acids would show this behaviour?</p>			
		H	J	
	A	H_3PO_4	HCl	
	B	HCl	$\text{CH}_3\text{CO}_2\text{H}$	
	C	HCl	H_2SO_4	
	D	$\text{CH}_3\text{CO}_2\text{H}$	H_2SO_4	
	<p>Answer: B</p> <p>H is a strong acid and J is a weak acid.</p> <p>Strong acid: $\text{pH} = -\lg [\text{strong acid}]$</p> <p>Weak acid: $\text{pH} = -\lg \sqrt{K_a \times [\text{Weak acid}]}$</p> <p>As shown from the equations, the pH of the strong acid will increase more than that of the weak acid when both are diluted to the same extent.</p>			

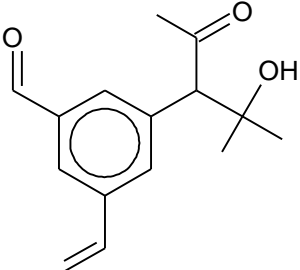
14	What is the total number of isomers possible for the molecular formula of $C_2H_2Br_2$?			
	A	1	C	3
	B	2	D	4
	<p>Answer: C</p> 			
15	Which statement is incorrect for the compound shown below?			
				
	A	There are 6 π bonds.		
	B	There are 8 σ bonds.		
	C	There are two different bond angles.		
	D	There are three sp^2 hybridised carbons.		
	<p>Answer: D</p> 			
16	Samples of $C_6H_5CHCH_2$ and Br_2 were mixed under different conditions. Which pair of conditions and products are correctly paired together?			
		Conditions	Product	

	A	Br_2 (aq)	$\text{C}_6\text{H}_4\text{BrCH}(\text{OH})\text{CH}_2\text{Br}$	
	B	Br_2 (g), uv light	$\text{C}_6\text{H}_4\text{BrCHCH}_2$	
	C	Br_2 (g)	$\text{C}_6\text{H}_4\text{BrCH}(\text{Br})\text{CH}_2\text{Br}$	
	D	Br_2 (g), Fe (s)	$\text{C}_6\text{H}_4\text{BrCH}(\text{Br})\text{CH}_2\text{Br}$	
Answer: D Both electrophilic substitution and electrophilic addition took place when exposed to Br_2 (g), Fe (s).				
17	Which of these statements is true for the reaction of 2,3,4-trimethylpenta-2,3,4-triol with concentrated sulfuric acid at 443 K.			
	A	Oxidation reaction taken place.		
	B	Carbon dioxide gas is a by-product.		
	C	There are a total of 8 possible geometrical isomers.		
	D	Organic product with three carbon-carbon double bonds is formed.		
Answer: D 				
18	Which of the following reagents and conditions will not yield any reaction with the compound shown below.			
				
	A	Cold aqueous hydrogen cyanide with trace amounts of sodium hydroxide.		
	B	Hot potassium dichromate in aqueous potassium hydroxide.		
	C	Cold potassium manganate(VII) in aqueous sulfuric acid.		
	D	Aqueous sodium hydroxide and heat.		
Answer: A				

	Cold aqueous hydrogen cyanide with trace amounts of sodium hydroxide is the reagent and conditions for nucleophilic addition of carbonyls	
19	Which of the following compounds would be the most inert towards a nucleophilic attack?	
	A	
	B	
	C	
	D	
	<p>Answer: A</p> <p>C–Cl bond in chlorobenzene is very strong and cannot be broken easily.</p>	
20	<p>Penta-1,3-diene was heated with acidified potassium manganate(VII) to form compound L and M.</p> <p>Compound L was then added to lithium aluminium hydride in dry ether to form compound N. Compound N was then bubbled with hydrogen bromide gas to form compound O.</p> <p>Which of these statements can be correctly deduced from the information above?</p>	
	A	Compound O cannot undergo further nucleophilic substitution with ethanolic potassium cyanide.
	B	1 mol of compound N forms 1 mol of hydrogen gas when reacted with sodium metal.

	C	Compound L is a gas which forms white precipitate with calcium hydroxide.
	D	Compound M is a non-polar acidic gas.
	<p>Answer: D</p> <div style="text-align: center;"> <p style="margin-left: 100px;"> $\text{H}_3\text{C}-\text{CH}=\text{CH}-\text{CH}_2\text{CH}_3 \longrightarrow \text{H}_3\text{C}-\text{COOH} + \text{CO}_2$ L M </p> <p style="margin-left: 100px;"> $\text{H}_3\text{C}-\text{COOH} \xrightarrow{[\text{R}]} \text{H}_3\text{C}-\text{CH}_2\text{OH} \xrightarrow{\text{HBr}} \text{H}_3\text{C}-\text{CH}_2\text{Br}$ N O </p> </div> <p>Compound M is carbon dioxide which is a non-polar acidic gas.</p>	
21	<p>Buta-2,3-diol can be oxidized by NaIO_4 as shown below,</p> <div style="text-align: center;"> <p style="margin-left: 100px;"> $\text{CH}_3\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_3 \xrightarrow{\text{NaIO}_4} 2 \text{ CH}_3\text{CHO}$ </p> </div> <p>What would be the final organic products obtained when compound P is first treated with cold alkaline aqueous KMnO_4 followed by NaIO_4?</p> <p style="text-align: center;">Compound P is $\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)-\text{CH}_2-\text{CH}=\text{CH}(\text{CH}_3)$</p>	
	A	
	B	
	C	

	D	
	Answer: A	
22	Which reagent could be used to distinguish between pentan-2-ol and pentan-2-one?	
	A	Acidified potassium manganate(VII)
	B	Alkaline aqueous iodine
	C	Sodium carbonate
	D	Aqueous bromine
	Answer: A	<p>A: Pentan-2-ol, a 2° alcohol can be oxidised by acidified potassium manganate(VII) to form a ketone. Purple solution decolourise</p> <p>B: Both react with aq I₂.</p> <p>C: Both do not react with Na₂CO₃.</p> <p>D: Both do not react with aqueous bromine.</p>
23	Which of the following chemical tests will yield a positive observation with the compound shown below?	

		
	A	Fehling's solution
	B	Hot ethanolic silver nitrate
	C	Sodium carbonate
	D	Alkaline aqueous iodine
	<p>Answer: D</p> <p>Brown iodine solution will decolourise due to the alkene functional group and methyl ketone present in the side chains.</p>	
24	Which compound can undergo a reaction when treated with hot ethanolic potassium hydroxide?	
	A	CH_2Br_2
	B	CBr_3CBr_3
	C	$(\text{CH}_3)_2\text{CCBr}_2$
	D	$\text{CH}_3\text{CBr}_2\text{CH}_3$
	<p>Answer: D</p> <p>Only compound D has a bromine atom on a carbon with an adjacent carbon atom that has a H atom for it to undergo elimination.</p>	
25	Which of these would have the lowest pH value in solution?	
	A	$\text{CH}_2(\text{Cl})\text{CH}_2\text{CO}_2\text{H}$
	B	$\text{CH}_2\text{CH}(\text{Cl})\text{CO}_2\text{H}$
	C	$\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_3$
	D	$\text{CH}_3\text{CH}_2\text{NH}_2$
	<p>Answer: B</p> <p>The electron withdrawing chlorine atom is nearer to COO^- and the negative charge is more dispersed, hence stabilising the anion.</p>	

For **questions 26 – 30**, one or more of the numbered statements **1** to **3** may be correct. Decide whether each of the statements is or is not correct. The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is to be used as correct response.

26	Which of the following contain hydrogen bonding?	
	1	NH_4Cl (s)
	2	$\text{NH}_3(l)$
	3	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ (l)
	<p>Answer: C (2 & 3 are correct only)</p> <p>1: Ionic salt. No hydrogen bonding</p> <p>2 and 3: Both NH_3 and $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$: Both can form intermolecular hydrogen bonding as they have lone pairs on N and O, with H attached to N and O respectively.</p>	
27	Which reaction represents standard enthalpy change at 298 K?	
	1	$\text{HBr (aq)} + \text{NaOH (aq)} \rightarrow \text{NaBr (aq)} + \text{H}_2\text{O (l)}$
	2	$\text{P}_4 \text{ (s)} \rightarrow 4\text{P (g)}$
	3	$\text{H}_2 \text{ (g)} + \text{Br}_2 \text{ (g)} \rightarrow 2\text{HBr (g)}$
	<p>Answer: B (1 & 2 are correct only)</p> <p>Bromine is a liquid and not a gas at 298 k.</p>	
28	At 50 °C, pure water is found to have a pH value of 6.6. Which of the following statements are true?	
	1	Concentration of hydrogen ion in water is higher at 50 °C compared to at 25°C.
	2	The K_w value is smaller at 50 °C compared to at 25°C
	3	Water is acidic at 50 °C
	<p>Answer: D (only 1 is correct)</p>	

		<p>1: Since $\text{pH} = -\lg [\text{H}^+]$, $[\text{H}^+]$ is higher at pH 6.6 at 50 °C compared to pH 7 at 25°C.</p> <p>2: K_w is temperature dependent and is larger at higher temperatures, as H_2O dissociation is endothermic</p> <p>3: $[\text{OH}^-] = [\text{H}^+]$, water is still neutral at 50 °C.</p>
29		Which of these compounds are planar?
	1	Ethene
	2	Benzene
	3	Propanone
		<p>Answer: B (1 & 2 only)</p> <p>Propanone is not planar due to the two CH_3 groups being tetrahedral in shape</p>
30		<p>Glucose is a simple molecular solid.</p> <p style="text-align: center;">$\text{HOCH}_2\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CHO}$</p> <p>Which of the following statements are correct?</p>
	1	The hydrogen atom in the hydroxyl groups can form hydrogen bonds with water.
	2	The hydrogen atom in the aldehyde group form hydrogen bonds with ethanol.
	3	All the oxygen atoms in glucose can form hydrogen bonds with propanone.
		<p>Answer: D</p> <p>1 Hydrogen is directly bonded to oxygen in the hydroxyl group, hence it can form hydrogen bonds with water.</p> <p>2: Hydrogen in aldehyde is not bonded to oxygen, hence no hydrogen bonds can be formed</p> <p>3: There are no hydrogen atoms bonded directly to oxygen in propanone, hence no hydrogen bonds can be formed.</p>

END OF PAPER

P1 SOLUTIONS

1	B	11	A	21	A
2	C	12	D	22	A
3	C	13	B	23	D
4	D	14	C	24	D
5	C	15	D	25	B
6	A	16	D	26	C
7	B	17	D	27	B
8	D	18	A	28	D
9	B	19	A	29	B
10	B	20	D	30	D