ANDERSON SERANGOON JUNIOR COLLEGE



NAME:	()	CLASS: 22 /
CHEMISTRY		9729/01
Paper 1 Multiple Choice		21 September 2022
		1 hour

Additional Materials:	Multiple Choice Answer Shee	
	Data Booklet	

READ THESE INSTRUCTIONS FIRST

Please look through the marks scheme and understand the concepts tested in each question.

Do pay attention as the tutor go through selected questions in lecture.

If you still have further questions, you may check with your tutor at your own time. Be proactive in asking questions. If you do not ask now, then when?

Remember the power of tiny gains and be a little better every day!

1 Ans: **D**

Statement A is incorrect. Electrons has a larger e/m ratio and hence will be deflected to a larger extent than protons.

Statement C is incorrect. Electron beam should be deflected towards the positively charged plate.

Statement B is incorrect and D is correct. Proton beam travels in a parabolic path towards the negatively charged plate.

2 Ans: C

There is a large increase in the 7th to 8th ionisation energy. This means that the 8th electron is removed from the inner principal quantum shell and element **D** is from Group 17. Its valence configuration will be ns^2np^5 . Hence the 5th electron is from the p subshell and 6th electron is from the s subshell.

While it is possible that **D** is fluorine (i.e. in Period 2), it <u>cannot</u> be conclusively inferred from the data given as element **D** may have more than 9 electrons. However, if the 10^{th} I.E. is given, we can conclude that **D** is not fluorine in Period 2.

3 Ans: D

1: C-Cl bond is polar and there are 2 Cl bonds in molecule I, thus it is more polar than molecule II.

2: The dipole moments associated with the polar C-Cl bond is canceled out in the trans molecule. Thus, the cis isomer is more polar.

3: The dipole moments associated with the polar C-Cl bond is canceled out in the trans molecule. Thus, molecule I is more polar.

4: C-F bond is more polar than C-Cl bond. Thus, molecule I is more polar.

4 Ans: **A**

E has simple molecular structure with low m.p because little amount of energy is needed to overcome the weak intermolecular forces of attraction. It is unable to conduct electricity in any state due to absence of mobile charge carriers.

F has giant ionic lattice structure with high m.p because large amount of energy is needed to overcome the strong electrostatic forces of attraction between the oppositely charged ions. It conducts electricity in aqueous and molten state due to the presence of mobile ions.

G has giant metallic lattice structure with high m.p because large amount of energy is needed to overcome the strong metallic bonds. It conducts electricity in solid and molten state due to the presence of delocalised electrons.

H is SiO_2 . It has giant molecular structure with high m.p because large amount of energy is needed to overcome the strong and extensive covalent bonds between the atoms. It cannot conducts electricity in solid state because there is no mobile charge carriers.

5 Ans: **D**

Gas J deviates more than gas K from ideality and hence have stronger intermolecular forces of attraction.

A: O_2 has a greater electron cloud size and has greater ease of distortion of electron cloud. Hence it has stronger instantaneous dipole-induced dipole interactions between O_2 molecules and should deviate more.

B: HI has a greater electron cloud size and has greater ease of distortion of electron cloud. Hence it has stronger instantaneous dipole-induced dipole interactions between HI molecules and should deviate more. HI should be gas **J**.

C: H₂O has stronger intermolecular hydrogen bonds and should deviate more.

D: HBr is polar and F_2 is non-polar. Hence, HBr has stronger permanent-dipole induced dipole interactions and deviate more.

6 Ans: C

$$pV = nRT$$
$$V = \frac{nRT}{p}$$
$$V = \frac{\frac{mRT}{p}}{p}$$

Since R, mass, pressure and temperature are constant, volume is proportional to $\frac{1}{Mr}$

	NH ₃	CH₃C <i>l</i>	CH_2Cl_2	HCOOH
Mr	17	50.5	85	46

7 Ans: **B**

Lattice energy $\alpha \mid \frac{q_{+} \times q_{-}}{r_{+} + r_{-}} \mid$

bonds within molecules instead.

Cationic charge: $Mg^{2+} > Na^+$ Anionic charge: $O^{2-} > Cl^-$ Cationic radius: $Mg^{2+} < Na^+$ Magnitude of lattice energy: MgO > MgCl₂ > NaCl

8 Answer: B

During vapourisation, molecules need to overcome intermolecular forces of attraction to move further apart to convert to gaseous states. Atomisation is to convert molecules into atoms and that would need to break strong covalent

9 Answer: B

comparing expt I and II, when [sucrose] increased 1.5times, the initial rate increased by 1.5times. Since rate of reaction is directly proportional to [sucrose], order of reaction wrt sucrose is <u>1</u>.

comparing expt I and III, when [HCl] is tripled, the initial rate tripled. Since the rate of reaction is directly proportional to [HCl], order of reaction wrt HCl is <u>1</u>.

rate = k [HCl] [sucrose] rate = k [sucrose]

where k' = k [HCl] ... HCl is a <u>catalyst</u> and its concentration remains constant

Since the half-life of expt I is 3.0 s and

 $t_{\frac{1}{2}} = \frac{\ln 2}{k'} = \frac{\ln 2}{k [HCI]_{I}} = 3.0s \text{ for } 1^{st} \text{ order reaction wrt sucrose,}$

expt II Since [HC*l*] is constant, half–life for expt II will <u>remain as 3.0 s</u>.

expt III As [HCl] is tripled, half-life for expt III will be 1.0 s

$$(t_{\frac{1}{2}} \text{ for expt III} = \frac{\ln 2}{k [\text{HCI}]_{\text{III}}} = \frac{\ln 2}{k(3[\text{HCI}]_{I})} = \frac{1}{3}(\frac{\ln 2}{k [\text{HCI}]_{I}}) = \frac{1}{3}(3.0) = \underline{1.0 \text{ s}})$$

10 Answer: C

The rate equation / order of reaction of a reaction can be derived from the <u>stoichiometric</u> <u>coefficients</u> of the species involved in the <u>slow step</u>, including preceding fast step(s).

- 1 is consistent. 1 mol of H_2O_2 reacts with 1 mol of I⁻ in the slow step (r.d.s.), which is also the first step. Hence the rate equation is as shown.
- 2 is inconsistent. Correct rate equation should be rate = k_2 [H₂] since only 1 mol of H₂ is involved in the slow step.
- **3** is consistent. As the slow step is not the first step, you need to consider the preceding fast step. Based on the elementary step, rate = k_3 [HBrO] [HBr] However, HBrO is an intermediate and its concentration is dependent on the reaction between HBr and O₂ so you need to include this in the rate equation.

Shortcut for consideration: If the intermediate is the ONLY product formed in the preceding fast step, you can just change its stoichiometric coefficient to be the same as that in the slow step. Similarly, multiply by the same factor for the reactants in the fast step. In this case, the mechanism can be rewritten as

HBr + 1/2O₂
$$\xrightarrow{\text{fast}}$$
 HBrO
HBrO + HBr $\xrightarrow{\text{slow}}$ H₂O + Br₂
Hence the rate equation is rate = k_3 [HBr] [HBrO]
= k_3' [HBr] [HBr] [O₂]^{1/2}
= k_3' [HBr]² [O₂]^{1/2}

11 Answer: D

Since this is a first order reaction based on the rate constant units, only the half-life remains constant.

Option A: Rate should decrease as the pressure of reactant decreases.

Option B: The total pressure should increase as the volume remains constant but more gas products are formed.

Option C: The rate constant is different without the use of gold as reaction rate will decrease.

12 Answer: D

Options 2 and 3 are incorrect.

Option 2: Decreasing the partial pressure of nitrogen will decrease the rate of reaction even though the POE will eventually shift to the left.

Option 3: Adding a catalyst should affect the rate constant since it increases the rate of reaction without concentration change.

13 Answer: D

 $H^{+}(aq) + F^{-}(aq) \longrightarrow HF(aq) -----(1)$ MgF₂(s) $\longrightarrow Mg^{2+}(aq) + 2F^{-}(aq) -----(2)$

Towards lower pH as $[H^+]$ increases, POE for equation (1) shifts right. This results in a decrease in $[F^-]$ in equation (2).

By LCP, POE for equation (2) shifts right to increase [F⁻], thus increasing the solubility of MgF₂.

14 Answer: C

 $H_2O = H^+ + OH^- - - - - (1)$

 $K_{\rm w} = [\rm H^+][\rm OH^-]$

When temperature increases, K_w increases, indicating POE for (1) shifts right to absorb additional heat. Thus the ionization of water is endothermic.

As POE shifts right, $[H^+]$ and $[OH^-]$ increases to the same amount.

 K_w at 10 °C is lower than 1.00 x 10⁻¹⁴ mol² dm⁻⁶. [H⁺] at 10°C will be less than $\sqrt{(1 \times 10^{-14})}$, pH will be higher than at 25 °C.

15 Answer: D

Statement 1 is incorrect as the lone pair is NOT delocalised; the lone pair is localised on the sp hybridised N atom of the nitrile group. Furthermore, the strength of the C-N bond does not impact the availability of the lone pair for donation to a proton.

Statement 2 is correct. Observing the nitrile is neutral, while the amine is basic indicates that the lone pair on the N of nitrile is not available for donation to a proton. This is due to the sp hybridised state of N in nitrile has higher s character than the sp³ hybridised state of N in amine. This results in stronger attraction of the nucleus on the lone pair, making it less available to accept proton.

Statement 3 is incorrect. The **size** of the alkyl group does <u>not</u> affect the extent of electron donating effects significantly.

You may have thought that statement 3 is correct because of what you read in the Hydroxy Compounds lecture notes pg 25. However, please note that the difference in electron donating effect between alkyl groups of different sizes is insignificant (in fact you will only see very slight difference in pK_a values of ethanoic acid vs propanoic acid) and it has never been mentioned as a reason to significantly impact basicity of organic compounds such that one compound is basic while the other is neutral.

If you are interested to read up more, you may see this website that is related to our syllabus: https://www.chemguide.co.uk/basicorg/acidbase/acids.html

16 Answer: A

Complete combustion of an aliphatic alkane and an alkene can be represented by:

$$C_{n}H_{2n+2} + \left(\frac{3n+1}{2}\right)O_{2} \rightarrow nCO_{2} + (n+1)H_{2}O$$

$$C_{n}H_{2n} + \frac{3n}{2}O_{2} \rightarrow nCO_{2} + nH_{2}O$$

At 298 K, H₂O is a liquid. The same volume of CO₂ would be produced for both combustions.

D is incorrect.

Directly proportional means the ratio of C to O_2 should be a constant value that does not change as the number of C atoms increase.

It is hence not directly proportional for combustion of alkane because the ratio does not remain constant.

value of n	coefficient of O ₂	ratio (n:coefficient of O ₂)
1	2	1:2
2	3.5	1:1.75
3	5	1:1.67

17 Answer: C (1 only)

L is the cis isomer, M is the trans isomer. There is restricted rotation about the C-C due to presence of the cyclic structure.

L is not optically active as it has an internal plane of symmetry (meso compound). **M** is optically active as it has two chiral centres but no plane of symmetry.

Thus, L and M are not a pair of enantiomers and will not form a racemic mixture.



19 Answer: B

This question can be solved either by pattern recognition or using the info on the mechanism it undergoes ($S_N 2$).

 $I^{\scriptscriptstyle -}$ will attack the electron deficient carbon with less steric hindrance (S_N2) and hence the C–O



bonds will cleave as shown



21 Answer: A

Option 1: $(CH_3)_2NH$ is more basic than CH_3NH_2 as it has more electron donating alkyl group, increasing the availability of the lone pair to accept proton. Option 2: $CH_3COCH_2NH_2$ (amine) is <u>basic</u> while $CH_3CH_2CONH_2$ (amide) is <u>neutral</u>. Option 3: C_6H_5OH is a weaker acid than $C_6H_5CO_2H$, hence its <u>conjugate base</u> ($C_6H_5O^-$) is a <u>stronger base</u> than $C_6H_5CO_2^-$.

22 Answer: A

K is an aldehyde and reduces $Ag(NH_3)_2^+$ to Ag metal which appears as a black solid.



23 Answer: B

Reactive C	Option 1	Option 2	Option 3
Mechanism	Electrophilic substitution	S_N1 mechanism	Free radical substitution
Before reaction	Trigonal planar	Tetrahedral	Tetrahedral
Intermediate	CH ₃ CH ₂ H Br	CH ₃ CH ₃ -C ⊕	HC-
	Tetrahedral	Trigonal planar	Trigonal planar (note that alkyl radicals are sp² hybridised)

24 Answer: D

Addition reaction will involve breaking a π bond of the benzene, hence disrupting the continuous π electron cloud and destroying the resonance stability of the benzene ring.

25 Answer: D

Question tests the concept of formation of ester from heating an alcohol and a carboxylic acid in the presence of concentrated H_2SO_4 . However, as concentrated H_2SO_4 is a dehydrating agent, elimination of water can also occur.

Option 1: Reacting ethanol with **P** will not yield **R**.

Option 2: Ethanol reacts with **P** as shown:



By-product, CH₃CH₂OCOCH(OH)CH₃ shown, cannot be obtained.

- Option 3: Two CH₃CH(OH)CO₂H molecules can undergo ester formation to yield the byproduct cyclic ester shown.
- 26 Answer: D

Si is a semiconductor which can only give rise to delocalised electrons at high temperatures. SiC $l_4(I)$ has a simple molecular structure hence is a non–conductor of electricity. SiC $l_4(I) + 4H_2O(I) \rightarrow SiO_2.2H_2O(s) + 4HCl(aq)$

27 Answer: C

1 is wrong – this is a precipitation reaction between Fe^{3+} and $Fe(CN)_6^{4-}$, there is no redox reaction occurring as OS of Fe does not change 2 is correct – CN^- ligands from $K_3Fe(CN)_6$ displaces H_2O ligands from $FeCl_2$ and in turn

produces Prussian blue, $Fe_4[Fe(CN)_6]_3$, via precipitation 3 is correct – Prussian blue is an insoluble pigment (blue ppt) and the resultant solution is KC*l* which is a colourless solution

28 Answer: C

Ag⁺ would be colourless as it as a fully filled 4d subshell $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10})$ It is in the same group (group 11) as copper and hence Ag⁺ would have a similar valence d subshell electronic configuration as Cu⁺

29 Answer: B

Mg²⁺+ 2e \Rightarrow Mg E^θ = -2.38V (E^θ less positive, [O] occurs at this half-cell) → anode (negative terminal)

Fe³⁺ + e = Fe²⁺ E^θ = +0.77V (E more positive, [R] occurs at this half-cell) → cathode (positive terminal)

B is correct. Size of solid electrode has no effect on the reactions in both half-cell. C is incorrect. Addition of water dilutes the Fe^{2+} and Fe^{3+} ions equally, equilibrium position does not shift.

D is not true. Pressure is not a factor as there are no gaseous species involved in the electrochemical cell.

30 Answer: C

Since seawater is assumed to be dilute aqueous NaCl and with reference to the E^{θ} values for the oxidation of H₂O and Cl⁻ at the anode, and for the reduction of H₂O and Na⁺ at the cathode, it can be deduced that H₂O would undergo oxidation at the anode and reduction at the cathode.

Hence from 0 h to 90 h, $[Cl^{-}]$ is increasing due to H₂O reacting away.

From 90 h onwards, $[Cl^-]$ is decreasing. This suggests that the aqueous NaCl solution is now concentrated enough that Cl^- is preferentially oxidised (ie, brine).

Anode:Cathode: $2H_2O \rightarrow O_2 + 4H^+ + 4e^ 2H_2O + 2e^- \rightarrow H_2 + 2OH^ 2Cl^- \rightarrow Cl_2 + 2e^ 2H_2O + 2e^- \rightarrow H_2 + 2OH^-$

Option A is correct

Option B is correct as the graph shows a linear increase in [Cr]

Option D is correct as at 20 h, H^+ is a product at the anode and OH^- is a product at the cathode

Option C is wrong as at 60 h, H_2O would undergo oxidation at the anode and reduction at the cathode, but given the same current supplied for the 60 h of electrolysis, there would be twice the volume of H_2 produced compared to O_2 as seen by the electrons transferred from both anode-cathode half-equations above.