ST ANDREW’S JUNIOR COLLEGE

JC2 Preliminary Examination (worked solutions)

Chemistry Higher 1 **8872/01**

Paper 1 Multiple Choice **19 September 2016**
50 minutes

Additional Materials: Multiple Choice Answer Sheet, Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil. Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **30** questions on 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 in soft pencil on the separate Answer Sheet.

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 booklet.

This document consists of **13** printed pages **including** this page.

Section A

1 Percentage by mass of C in ethanol = (12 x 2) / [(12 x 2) + 6 + 16] = 0.5217

Thus,

Mass of C in 11.5 g ethanol = 0.5217 x 11.5 = 6g

Therefore,

No. of moles of C in 11.5 g ethanol = 6/12 = 0.5

No. of carbon atoms in 11.5 g ethanol = 0.5 x *L* = 0.5L or *L*/2

Answer: B

2

	C	H	C*l*
%	24.2	4.1	71.2
Divide by Ar	24.2 / 12 = 2	4.1 / 1 = 4.1	71.2 / 35.5 = 2
Divide by smallest number	2 / 2 =1	4.1 / 2 = 2	2 / 2 =1
Ratio	1	2	1

Therefore, empirical formula of CFC-150a is CH_2Cl

Among the options, only D has this empirical formula

Answer: D

3 A: No change in oxidation number (O.N) of S, remaining at +6

B: O.N of S changed from +6 to +4

C: O.N of S changed from +6 to 0

D: O.N of S changed from +6 to -2, thus the biggest difference/change

Answer: D

4 Since **P** and **Q** are in the same period,

- **P** must come after **Q** to have more protons than **Q**
- To be after **Q** and have a lower 1st IE, **P** must be either Gp III (and **Q** Gp II) or Gp V (and **Q** Gp VI) as these are where the anomalies of the increasing 1st IE trend across the period.
- If **Q** is Gp II and **P** is Gp III, **P** has one more unpaired electron than **Q** as the valence electron configuration of **P** : **Q** would be ns^2 : ns^2 np^1; If **Q** is Gp V and **P** is Gp VI, **P** has one less unpaired electron than **Q** as the valence electron configuration of **P** : **Q** would be ns^2 np^4: ns^2 np^3

Thus, **P** must be in Gp VI while **Q** is in Gp V

Answer: C

5 A: $Ca(NO_3)_2$: There is ionic bonds between Ca^{2+} and NO_3^- as well as covalent bonds within the NO_3^- anion.

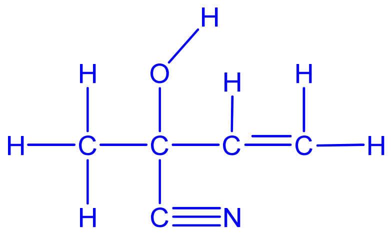
B: MgS: There is only ionic bonds between Mg^{2+} and S^{2-}.

C: Only contains metallic bonds given that it's a metal

D: SO_2: Only contains covalent bonds given that it's a giant covalent compound

Answer: A

6 Full structure of compound **R** is



The bond angles present are:

- 109.5° around C that have 4 sigma bonds
- 180° around the C of CN
- 120° around the C of C=C
- 105° around the O of O-H

Answer: B

7 A: False. Its not true as the order should be 4>3>1>2 as 2 is branched while 1 is straight chain so 1 should have more extensive id-id due to larger surface area when compared with 2.

B: False. As mentioned above, 2 is branched while 1 is straight chain so 1 should have more extensive id-id due to larger surface area when compared with 2, thus their melting point is not the same.

C: False. Predominant force for 3 is pd-pd but 4 is hydrogen bonding so different

D: True. Both 1 and 2 are non-polar so predominant interaction is id-id.

Answer: D

8 The ΔH of neutralisation between a strong acid and a strong base, as shown by the first example in the table above is -57 kJ.

Thus, for the values to be less exothermic than -57, it would mean that J must have been a weak acid (given that KOH is a strong base) and L is a weak base (given that nitric acid is a strong acid).

For the last one, the value is twice of that of -57. Hence it must be that M is a dibasic acid reacting with a diacidic base like $Ca(OH)_2$

Thus, J has to be propanoic acid, L is ethylamine and M is sulfuric acid

Ans: C

9 If enthalpy change of formation is given,

ΔH of any reaction = $\Sigma \Delta H_f$ (products) - $\Sigma \Delta H_f$ (reactants)

Thus,

$+70 = [\Delta H_f (Cl_2) + (2 \times \Delta H_f (O_2))] - (2 \times \Delta H_f (ClO_2))$

$= 0 + 0 - (2 \times \Delta H_f (ClO_2))$ [since Cl_2 and O_2 are both elements, thus $\Delta H_f = 0$]

Therefore,

$2 \times \Delta H_f (ClO_2) = -70$

$\Delta H_f (ClO_2) = -35$ kJ mol^{-1}

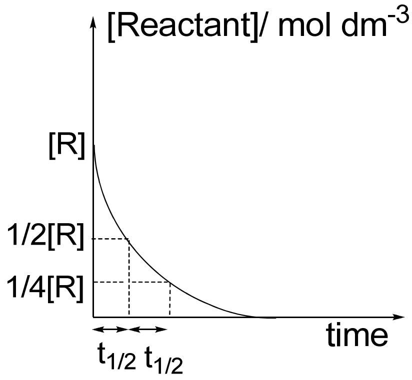
Ans: B

10 When concentration of E was halved, the rate would be halved, given that its first order with respect to E.

Hence, to get the overall rate to be doubled, F needs to increase by a factor of 2 so that the rate will be increase by 4 times (as its second order with respect to F)

Ans: C

11 For A, graph is



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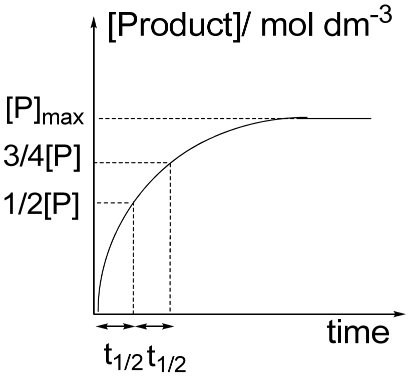
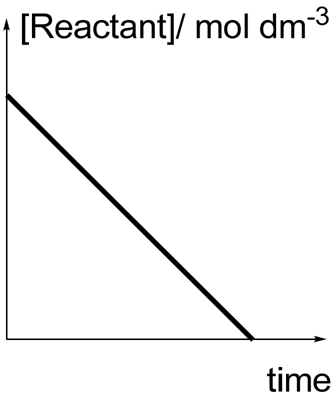


Thus its not a straight line

For B, graph is



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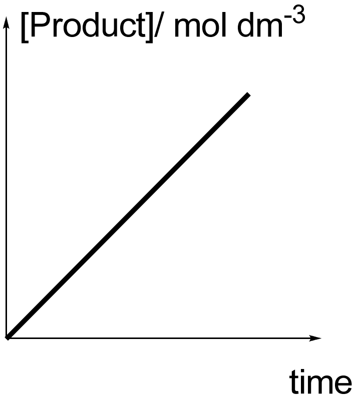
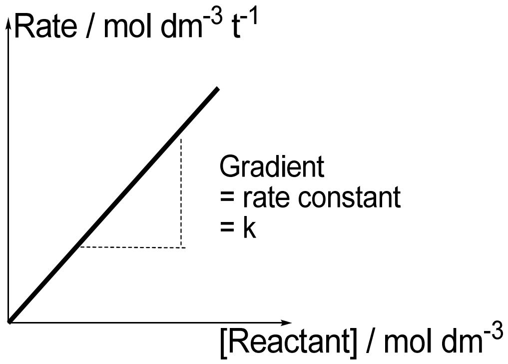


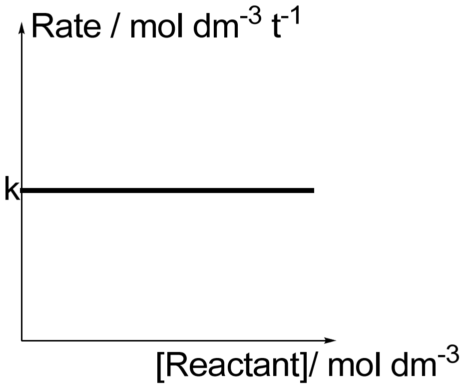
Thus its a straight line

For C, graph is



Thus its a straight line

For D, graph is



Thus its a straight line

Ans: A

12 Homogenous gaseous system implies all reactants and products are gases.

Thus, when pressure is increase and equilibrium shift to the right, it means that there are less gaseous molecules on the right so that pressure can be reduced.

Since K_c is [products] ^{x} / [reactants] ^{y}, x is less than y for this system resulting in units of such an equilibrium to be $(moldm^{-3})^{-z}$ resulting in units being $mol^{-z}dm^{3z}$.

Ans: A

13 Both acids are strong acids that dissociate completely. Therefore,

Total no. of moles of H^+ ions = [(50/1000) x 0.02] + [(150/1000) x 0.03] = 0.0055

Final concentration of H^+ ions = 0.0055 / (200/1000) = 0.0275

Therefore, pH = -log (0.0275) = 1.56

Ans: C

14 pH of such a solution = -log (1.00×10^{-6}) = 6

Thus, according to the table given, solution will appear blue in bromocresol-green as the pH of the solution is above its colour change pH range and yellow for phenol-red as the pH of the solution is below its colour change pH range.

Ans: B

15 For A, though more H^+ ion is produced at 50°C as equilibrium shift to the right. However, the same amount of OH^- ions is also produced making water still neutral and not more acidic. Hence false.

For B, at 50°C, equilibrium shift to the right and hence the K_w value will be larger than 1×10^{-14}. This explains why option D is false as well. Thus, the square root of a larger value to obtain the concentration of OH^- will be larger not smaller than 1×10^{-7}. Hence false.

For C, following the explanation for B, the H+ concentration will be larger than 1×10^{-7} as well, resulting in a pH (which is the –log of a value larger than 1×10^{-7}) smaller than 7. Hence true.

Ans: C

16 For A, its decreasing as atomic radius decrease across the period.

For B, its decreasing as well as electrical conductivity decreases across the period from Na to P.

For C, its also decreasing as ionic radius of cations decreases as long as they are in the same period.

For D, although melting point decrease from Si to P, but S has a higher melting point than P as the number of electrons for S is more in the form of S_8 as compared to P in the form of P_4. This results in stronger id-id for S than for P. Hence its not decreasing.

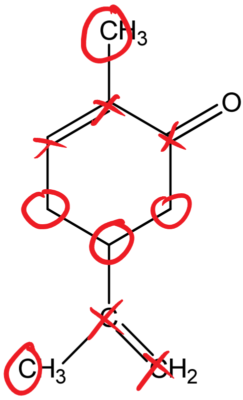
Ans: D

17 For method 1, after heating both in oxygen, Al_2O_3 and SiO_2 will be obtained. Only Al_2O_3 will react with acid as it is amphoteric but SiO_2 will have no reaction with water. Hence method 1 is able to help identify them.

For method 2, after heating both in chlorine, $AlCl_3$ and $SiCl_4$ will be obtained. Due to the aqueous nature of the base, $AlCl_3$ will dissolve aqueous ions but $SiCl_4$ will give solid $SiO_2.2H_2O$, which does not dissolve in a base. Hence method 2 can also help to identify them.

Ans: C

18

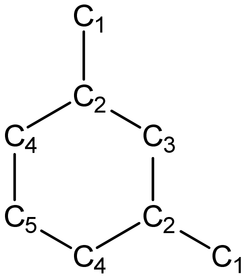


✗: sp^2 hybrdised ○: sp^3 hybrdised

Thus there are 5 sp^2 hybridised carbon atoms and 5 sp^3 hydridised carbon atoms

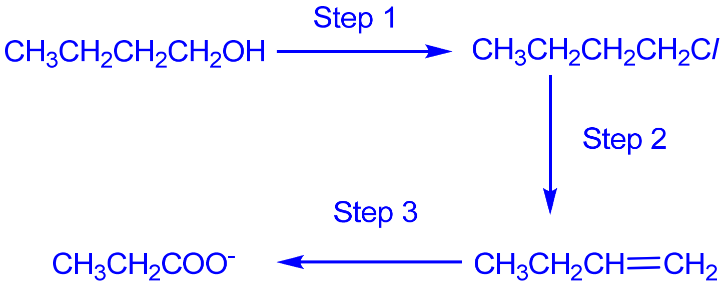
ANs: C

19 The following shows the labelled diagram of 1,3-dimethylcyclohexane where chlorine can substitute to result in mono-substituted chlorinated isomers. Carbons that show the same product are labelled as the same carbon as well.



Ans: C

20



End product: sodium propanoate

Ans: D

21 The precipitate after adding $AgNO_3$ is Ag*Cl*. No. of moles of Ag*Cl*

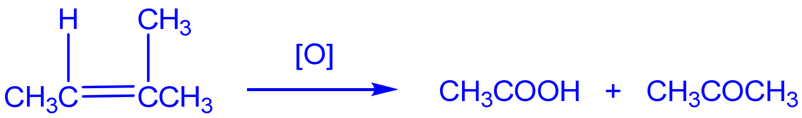
= 28.7 / (108+35.5) = 0.2

Thus, mole ratio of compound **G** with Ag*Cl* is 1: 2, implying 2 C-*Cl* bonds can be broken when the compound is heated with NaOH.

Option A has 3C-*Cl* bonds can break, B has 2C-*Cl* bonds can break, C has 3C-*Cl* bonds can break, D has no C-*Cl* bonds can break.

Ans: B

22



$$CH_3C(H)=C(CH_3)CH_3 \xrightarrow{[O]} CH_3COOH + CH_3COCH_3$$

IUPAC name of the reactant of the reaction above is 2-methylbut-2-ene.

Ans: B

23 A: Both compounds can be distinguish via iodoform which is an oxidation reaction.

B: Both compounds are not positional isomer but functional group isomers, therefore not the answer.

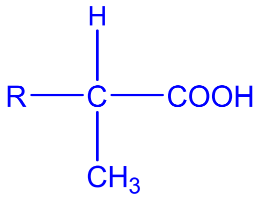
C: Both compounds can be oxidised so oxidation cannot distinguish them.

D: Both compounds can be oxidised so oxidation cannot distinguish them.

Ans: A

24

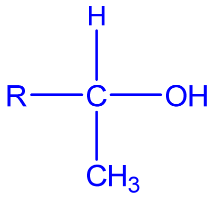
For A, the product of the reaction is



$R-\overset{\displaystyle H}{\underset{\displaystyle CH_3}{C}}-COOH$

which is Fenoprofen

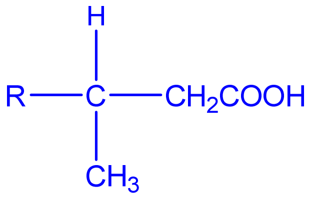
For B, the product of the reaction is



$R-\overset{\displaystyle H}{\underset{\displaystyle CH_3}{C}}-OH$

which is not Fenoprofen

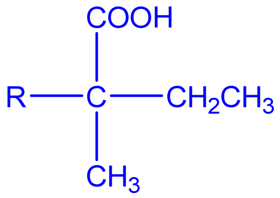
For C, the product of the reaction is



$R-\overset{\displaystyle H}{\underset{\displaystyle CH_3}{C}}-CH_2COOH$

which is not Fenoprofen

For D, the product of the reaction is



$R-\overset{\displaystyle COOH}{\underset{\displaystyle CH_3}{C}}-CH_2CH_3$

which is not Fenoprofen

Ans: A

25 For A, due to the ring of delocalised electrons which is a rich source of electrons, it attracts electrophiles rather than nucleophiles.

For B, due to the stability associated with the ring of delocalised electrons, reactions of benzene would want to re-establish it and hence undergo substitution rather than addition reaction.

For C, the ring of delocalised electrons help to stablise benzene compared to cyclohexa-1,3,5-triene. Hence the amount of energy needed to add hydrogen to both to form cyclohexane is less for benzene than cyclohexa-1,3,5-triene.

For D, benzene is planar as all the carbon is sp^2 hybridised. However, it has nothing to do with the ring of delocalised electrons.

Ans: D

Section B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct. Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be 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 used as a correct response.

26 When temperature is increase, the molecules will gain kinetic energy and hence move faster. This will result in them moving faster and collide more frequently (1). This would then result in more of them being able to overcome the activation energy or energy barrier of the reaction (2). However, the activation energy of the reaction does not change. Hence statement (3) is not correct. Therefore, only statement 1 and 2 are correct.

Ans: B

27 For 1,

$[OH^-] = 0.1$

pOH = 1 thus pH = 14 – 1 = 13

For 2,

$[OH^-] = 0.05 \times 2 = 0.1$ (as barium hydroxide is a diacidic base)

pOH = 1 thus pH = 14 – 1 = 13

For 3,

$[OH^-]$ is less than 0.1

pOH = more than 1 thus pH is less than 13

Only 1 and 2 are correct.

Ans: B

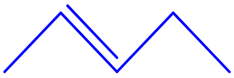
28 Statement 1 is correct as electronegativity increases across a period (until Gp VII)

Statement 2 is also correct as the oxides of the elements in the first few groups are metallic oxides and hence basic while the oxides of elements in the later groups are covalent oxides and hence acidic.

Statement 3 is not correct as maximum oxidation state of silicon is 4 but Cl can to 5 and more.

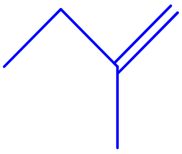
Ans: B

29 For 1, the product after elimination is



which can exhibit geometric or cis-trans isomerism.

For 2, the product after elimination is



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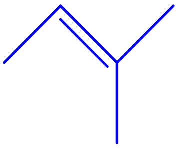
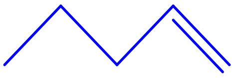


which both cannot exhibit geometric or cis-trans isomerism.

For 3, the product after elimination is



which cannot exhibit geometric or cis-trans isomerism.

Only 1 is correct.

Ans: D

30 For 1, its not possible as there is no carbonyl compound present in the molecule.

For 2, its possible due to both esters groups being able to undergo hydrolysis to break into its alcohol and acid groups.

For 3, due to the alkanes present, they can undergo substitution to obtain the halogenoalkane compound

Only 2 and 3 is correct.

Ans: C

~~~ END ~~~

Answers:

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