CANDIDATE NAME		CLASS	19S

ST ANDREW'S JUNIOR COLLEGE

JC2 Preliminary Examination

9729/01

CHEMISTRY

September 2020

Paper 1 Multiple Choice

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name and class on the Answer Sheet in the spaces provided.

There are **thirty** 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.

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

This document consists of **15** printed pages.

1 Carbon disulfide, CS_2, burns in oxygen according to the following equation.

$$CS_2(g) + 3O_2(g) \rightarrow CO_2(g) + 2SO_2(g)$$

10 cm^3 of carbon disulfide was completely burnt in 50 cm^3 of oxygen. The resulting mixture was then treated with excess of aqueous sodium hydroxide.

All measurements of volume were made at the same temperature and pressure in which all the reactant and products were in the gaseous state.

What was the volume of the gas after burning and after adding NaOH (aq)?

	volume of gas after burning / cm^3	volume of gas after adding NaOH(aq) / cm^3
A	30	10
B	30	20
C	50	20
D	50	40

Ans: C

Vol of excess O_2 = 20 cm^3

Volume of gas produced after burning = 20 + 10 + 20 = 50 cm^3

CO_2 and SO_2 are both acidic gases that reacts with aq NaOH.

vol of gas after adding aq NaOH = 50 – 30 = 20 cm^3

2 1 mole of $\mathbf{X}_2O_3^{2-}$ oxidised 68.1 dm^3 of sulfur dioxide gas to sulfate ions at standard temperature and pressure.

What is the final oxidation state of **X**?

A −2 **B** −1 **C** +1 **D** +2

Ans: B

$n(SO_2) = 68.1/22.7 = 3$

$SO_2 + 2H_2O \rightarrow SO_4^{2-} + 4H^+ + 2e$

$X_2O_3^{2-} : SO_2 : e$

1 : 3 : 6

1 mol of $X_2O_3^{2-}$ accepts 6 mol of e

1 mol of X accepts 3 mol of e

Initial OS of X is + 2, final OS of X is -1

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

Which species have the same number of unpaired electrons as chlorine atom?

1 Li^+

2 Mg^+

3 O^-

4 F^-

A 2 and 3

B 3 and 4

C 1 only

D 2 only

Ans: A

Chlorine has only one unpaired electron.

Li^+: $1s^2$

Mg^+: $[Ne]3s^1$

O^-: [He] 1s2 $2s^2 2p^5$

F-: [Ne]

4 Hospitals require large amount of oxygen gas in the treatment of patients with respiratory symptoms. Oxygen is liquefied under pressure and stored in special cylinders. It vapourises when pressure is released.

Which statement best describes why oxygen gas liquefies under pressure?

A High pressure lowers the kinetic energy of oxygen molecules, creating less disordered liquid state.

B High pressure pushes the molecules closer for more effective intermolecular interactions.

C High pressure causes the temperature of oxygen gas to increase above its boiling point.

D High pressure decreases the volume total occupied by the oxygen molecules.

Ans: B

The higher the pressure, the more particles there are per unit volume. Hence, the particles are closer in proximity. Hence, there are greater intermolecular forces between the gas particles.

5 Which species contain a dative (co-ordinate) bond?

1 CO

2 CO_3^{2-}

3 N_2H_4

4 N_2O_4

A 2, 3 and 4

B 1 and 2 only

C 1 and 4 only

D 3 and 4 only

Ans: C

Option 1 has a dative bond from O to C while option 5 has a dative bond between N to O. The rest have no dative bond present.

6 One proposed strategy to reduce the amount of greenhouse gases in the atmosphere is to capture carbon dioxide emissions from fossil fuel power plants and pump them into the deep ocean bed.

Under the extreme high pressure of the deep ocean bed, carbon dioxide would dissolve in water and stay out of the atmosphere.

$$CO_2(g) + nH_2O(l) \rightleftharpoons CO_2.nH_2O(aq)$$

What will be the signs of ΔH and ΔS for the forward reaction of this equilibrium at the deep ocean bed?

	ΔH	ΔS
A	–	–
B	–	+
C	+	–
D	+	+

Ans: A

$\Delta S < 0$ as there are no moles of gas in the products (more orderly)

$\Delta H < 0$ since interactions are formed between carbon dioxide and water.

7 The table shows the charge and radius of each of six ions.

Ion	J^+	L^+	M^{2+}	X^-	Y^-	Z^{2-}
Radius / nm	0.14	0.18	0.16	0.14	0.18	0.16

The ionic solids JX, LY and MZ are of the same lattice type.

What is the correct order of their lattice energies, placing the **least** exothermic first?

A JX, LY , MZ

B JX, MZ, LY

C LY, JX, MZ

D LY, MZ, JX

Ans: C

LE is inversely proportional to sum of ionic radius and directly proportional to multiplication of charges.

Hence LE of NP is the most exothermic as multiplication of charge outweighs the sum of the radii.

Both JK and LM have the same ionic charge. However, JK have a more exothermic LE as J and K have a smaller ionic radii than L and M respectively.

8 Ammonium nitrate is commonly used in making of fertilisers.

$$2NH_4NO_3(s) \rightarrow 2N_2(g) + 4H_2O(g) + O_2(g)$$

The decomposition of ammonium nitrate at 230°C give gases. It is a first-order reaction with a half-life of 10 min.

Explosion happens when the molar proportion of ammonium nitrate to gases is 1:14. How long would it take for ammonium nitrate to explode at 230°C?

A 23 min

B 35 min

C 70 min

D 80 min

$2NH_4NO_3(s) \rightarrow 2N_2(g) + 4H_2O(g) + O_2(g)$

initial	1	0	0	0
final	1- 2x	2x	4x	x

$$\frac{2x + 4x + x}{1 - 2x} = \frac{14}{1}$$

$7x = 14 - 28x$

$x = 0.4$

% of NH_4NO_3 left = 1 – 2 x 0.4 = 20%

$(0.5)^n = 0.2$

No of half-lives = 2.32

Time taken = 2.32 x 10 = 23.2 min

9 The reaction of nitrogen monoxide and hydrogen gas,

$$2NO(g) + 2H_2(g) \longrightarrow N_2(g) + 2H_2O(g)$$

involves the following steps:

I $NO + NO \rightleftharpoons N_2O_2$ (fast)

II $N_2O_2 + H_2 \longrightarrow H_2O + N_2O$ (slow)

III $N_2O + H_2 \longrightarrow N_2 + H_2O$ (fast)

Which statements about the reaction are **correct**?

1 N_2O acts as the catalyst.

2 The reaction is second order with respect to [NO].

3 The units of the rate constant is $mol^{-3}\,dm^{9}\,s^{-1}$

4 When partial pressure of H_2 doubles, rate of reaction quadruples.

A 1, 2 and 3

B 1 and 3 only

C 2 and 4 only

D 2 only

Ans: D

- Option 1 is incorrect as N_2O is an intermediate
- Option 2 is correct.

Based on the slow step:

Rate = $k\,[N_2O_2]\,[H_2]$

However, N_2O_2 is not present in the final equation, this shows that it is an intermediate and should not be present in the rate equation.

Based on step I,

Rate = $k[NO]^2[H_2]$

- Option 3 is incorrect.

Based on the rate equation, overall order is 3.

Hence units of rate constant = $mol^{-2}dm^6s^{-1}$

- Option 4 is incorrect.

Since H_2 is present in the rate equation, when $[H_2]$ is doubled, the rate is also doubled.

10 Given that the K_p for the following equilibrium is 125 at 65°C,

$$\mathbf{X}(s) + 3\mathbf{Y}(g) \rightleftharpoons 3\mathbf{Z}(g)$$

What is the mole ratio of **Y** : **Z** at equilibrium at 65°C?

A 1 : 1

B 1 : 5

C 25 : 1

D 125 : 1

Ans: B

$K_p = \frac{(P_Z)^3}{(P_Y)^3} = \frac{(n_Z)^3}{(n_Y)^3} = 125$

$\frac{n_Z}{n_Y} = 5$

$N_Z : n_Y = 1 : 5$

11 Boric acid, $B(OH)_3$, is often used as an antiseptic and as a precursor to other chemical compounds. The following equilibrium illustrates the acidity of boric acid.

$$B(OH)_3(aq) + 2H_2O(l) \rightleftharpoons B(OH)_4^-(aq) + H_3O^+(aq) \qquad K_a = 7.3\times10^{-10}$$

$NaB(OH)_4$ is a weak base. What is the pH of 0.20 mol dm^{-3} $NaB(OH)_4(aq)$?

A 9.1

B 9.4

C 11.2

D 13.3

Ans: C

$K_b = 10^{-14}/(7.3\times10^{-10}) = 1.3698 \times 10^{-5}$

$1.3698 \times 10^{-5} = [OH^-]^2/0.2$

$[OH^-] = 0.0016552$ mol dm^{-3}

pOH = 2.78

pH = 11.2

12 Human plasma is buffered mainly by dissolved CO_2, which reacts to form carbonic acid, H_2CO_3.

$$H_2CO_3(aq) \rightleftharpoons H^+(aq) + HCO_3^-(aq)$$

Given that the pH of human plasma is 7.4 and the acid dissociation constant, K_a, of carbonic acid is 8×10^{-7} mol dm^{-3}, which statements are correct?

1 The ratio of $[HCO_3^-]$ to $[H_2CO_3]$ in human plasma is 20 : 1.

2 The human plasma has a maximum buffer capacity at around pH 6.

3 This buffer system is more efficient in removing acid than base.

4 This buffer system can be prepared by mixing suitable amounts of sodium hydrogencarbonate and sodium hydroxide.

A 1, 2 and 3

B 1 and 3 only

C 2 and 4 only

D 3 only

Ans: A

Option 1 is correct: $[HCO_3^-] / [H_2CO_3] = K_a / [H^+] = 8 \times 10^{-7} / 10^{-7.4} = 20$

Option 2 is correct: At maximum buffer capacity, pH = pKa = 6

Option 3 is correct: Given the ratio of 20:1, hence there are more HCO_3^- present to remove H^+.

Option 4 is incorrect: The proposed mixture would produce a buffer of CO_3^{2-} and HCO_3^-. Hence, This buffer system can be prepared by mixing suitable amounts of carbonic acid and sodium hydroxide

13 Values of two solubility products of copper carbonate, $CuCO_3$, and neodymium carbonate, $Nd_2(CO_3)_3$ are given.

$$K_{sp}\ (CuCO_3) \quad = 1 \times 10^{-10}\ mol^2\ dm^{-6}$$

$$K_{sp}\ (Nd_2(CO_3)_3) \quad = 1 \times 10^{-33}\ mol^5\ dm^{-15}$$

Solid copper carbonate is shaken with water. The remaining solid is filtered off, leaving a saturated solution X.

Drops of dilute aqueous neodymium nitrate are added to X until neodymium carbonate just precipitates.

Which row of the table is correct?

	$[CO_3^{2-}]$ in X / mol dm^{-3}	$[Nd^{3+}(aq)]$ when $Nd_2(CO_3)_3$ just precipitates / mol dm^{-3}
A	1×10^{-5}	1×10^{-9}
B	1×10^{-5}	1×10^{-18}
C	5×10^{-11}	8×10^{-3}
D	5×10^{-11}	9×10^{-2}

Ans: A

$K_{sp}\ CuCO_3 = 1 \times 10^{-10}\ mol^2\ dm^{-6}$

$[CO_3^{2-}] = \sqrt{1 \times 10^{-10}} = 1 \times 10^{-5}\ mol\ dm^{-3}$

$K_{sp} = [Nd^{3+}]^2[CO_3^{2-}]^3$

$[Nd^{3+}]^2 = 1 \times 10^{-33} / (1 \times 10^{-5})^3 = 1 \times 10^{-18}$

Hence $[Nd^{3+}] = 1 \times 10^{-9}\ mol\ dm^{-3}$

14 Which statement about Period 3 elements and their oxides is **false**?

A The resultant pH of the oxides in water decrease across the period.

B The melting points of elements decrease across the period.

C The covalent character of oxides increase across the period.

D The maximum oxidation state of elements increases across the period.

Ans: B

Option A is true as the pH of the oxides in water change from basic to acidic.

Option B is false as there is an increase in melting point from Na to Si before decreasing.

Option C is true as Period 3 oxides change from ionic to ionic with covalent character to covalent across the period.

Option D is true as the oxidation state of the element change from +1 to +6 for oxides.

15 Which property generally increases down Group 2?

A sum of the first and second ionisation energies

B reactivity of metal with cold water

C polarising power of the cation

D oxidising power of the cation

Ans: B

E° (M^{2+}/M) more negative down the group. M is more easily oxidised, ie reactivity increases.

The size of the metal cation increases down the group, leading to a decrease in their charge density and polarising power.

Valence electrons are removed from an outershell that is further away from the nucleus. Sum of IE decreases as it is easier to remove the valence electrons due to weaker attraction with between nucleus and valence electron.

16 X_2, Y_2 and Z_2 are bromine, chlorine and iodine but not necessarily in the order given while X^-, Y^- and Z^- are their corresponding halide ions.

The table below shows the observations of two experiments involving the addition of these halogens to separate aqueous solutions containing the halide ions, followed by the addition of an organic solvent.

Experiment	Reactions	Observations
1	X_2 (aq) + Y^- (aq)	violet organic layer
2	Z_2 (aq) + X^- (aq)	violet organic layer

Which statement is correct?

A Reaction of X_2(aq) with Z^-(aq) would produce a different observation from experiments 1 and 2.

B Displacement took place in both experiments 1 and 2.

C X^- is a weaker reducing agent than both Y^- and Z^-.

D H-X bond is weaker than H-Y and H-Z bond.

Ans: D

From the observations given, both experiments yield iodine. Since X is the only common halogen/halide ion in both experiments, X_2/ X^- has to be iodine/iodide ion. One can only determine that Y and Z are above X in Group 17.

A: X_2 is the weakest oxidising agent and would not be able to oxidise Z^-. Hence, violet organic layer should still be observed

B: Displacement only took place in expt 2, resulting in X_2 being formed. There was no reaction in experiment 1 as X_2 is the least reactive among the 3 halogens.

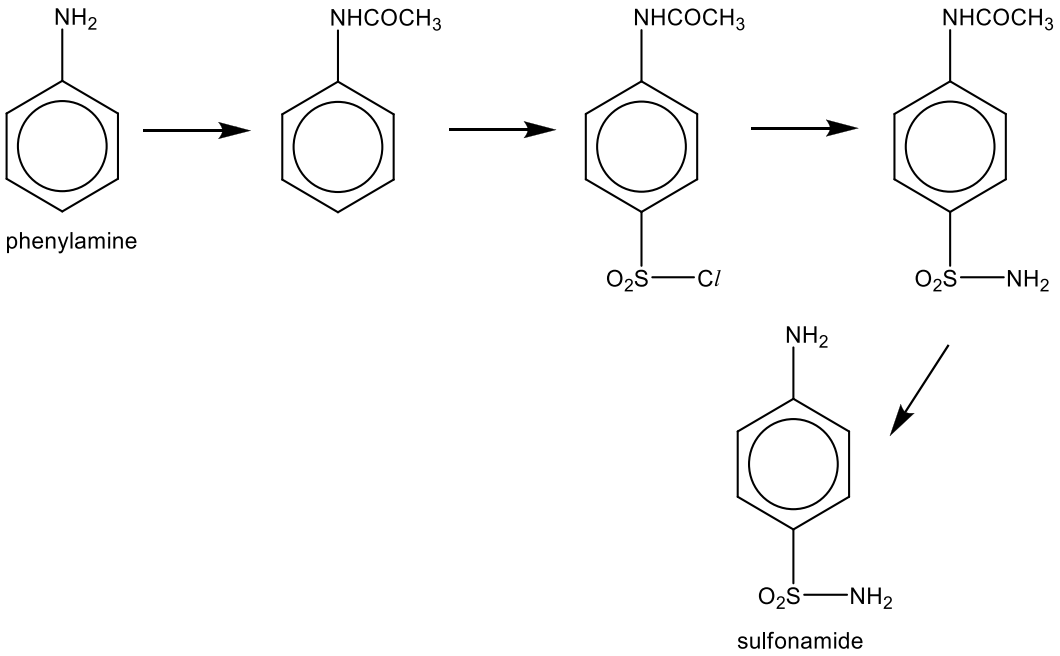
C: Incorrect as I^- is the strongest reducing agent among the halide ions.

D: Correct as H-I bond is the weakest among HCl and HBr.

Q17 and 18 will make reference to the structure of sulfonamide and its synthesis.

17 Sulfonamides are one of the earliest antimicrobial drugs developed in the laboratory.

The following scheme shows a synthesis of sulfonamide from phenylamine.



Which reactions are involved in the above synthesis?

1 Oxidation

2 Hydrolysis

3 Elimination

4 Substitution

A 1 and 3

B 2 and 3

C 2 and 4

D 4 only

Ans: C

The types of reaction reflected above (in sequence) are condensation/substitution, electrophilic substitution, nucleophilic substitution and hydrolysis.

18 Which bond angles are present in sulfonamide?

1 105°

2 107°

3 109.5°

4 120°

A 2, 3 and 4

B 2 and 3 only

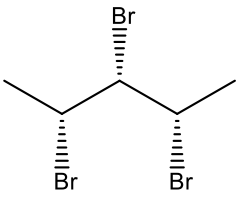
C 1 and 3 only

D 1 only

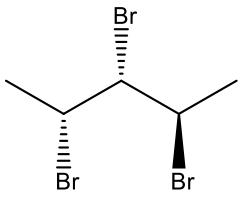
Ans: A

Bond angle around C in benzene is 120°. Bond angle around S is 109.5°. Bond angle around N is 107°

19 Which molecules are optically **inactive**?



1



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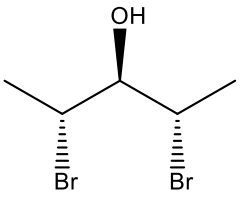

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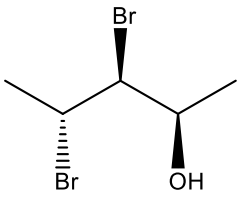


4

A 1 and 3

B 2 and 4

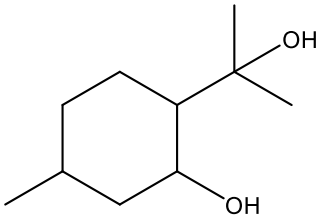
C 3 and 4

D 1 only

Ans: **A**

They have an internal plane of symmetry and are meso compounds.

20 Citriodiol is an active ingredient in insect repellent extracted from the lemon eucalyptus tree. It has the following structure.



citriodiol

Citriodiol is heated under reflux with acidified potassium dichromate (VII) to form compound **E**.

Which reagent reacts with **both** citriodiol and compound **E**?

A aqueous sodium bromide

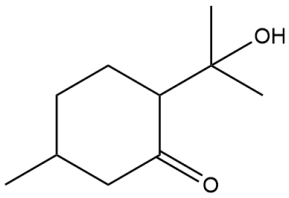
B 2,4-dinitrophenylhydrazine

C warm alkaline aqueous iodine

D hot concentrated sulfuric acid

Ans: D

Compound E has the following structure:



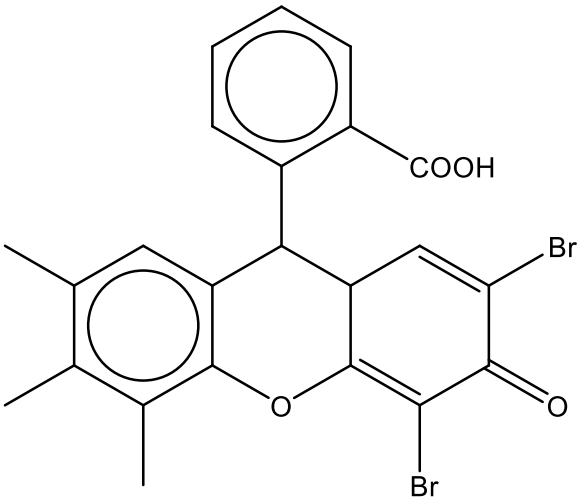
NaBr(aq) will react with neither compounds.

2,4-DNPH will only react with E.

Warm alkaline aq iodine will react with neither compounds

Both compounds have adjacent H and OH to undergo elimination with concentrated sulphuric acid.

21 The classic red colour from many lipsticks are obtained from pigments and dyes, such as the compound eosin. Eosin reacts with proteins of the skin to produce a deep red colour.



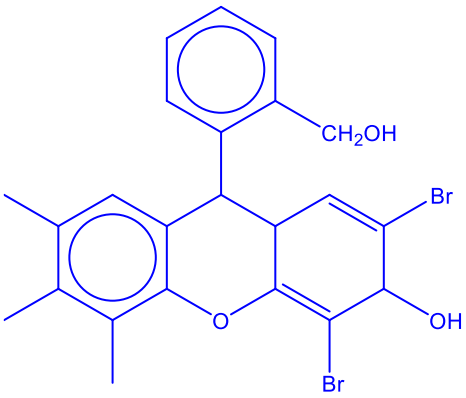
Eosin

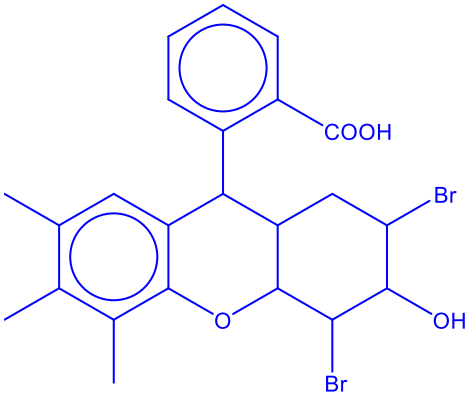
Eosin was reduced separately by $LiAlH_4$ and by H_2 + Pt.

What is the number of hydrogen atoms added to each molecule of eosin?

	$LiAlH_4$	H_2 + Pt
A	2	2
B	2	4
C	4	6
D	6	6

Ans: **C**





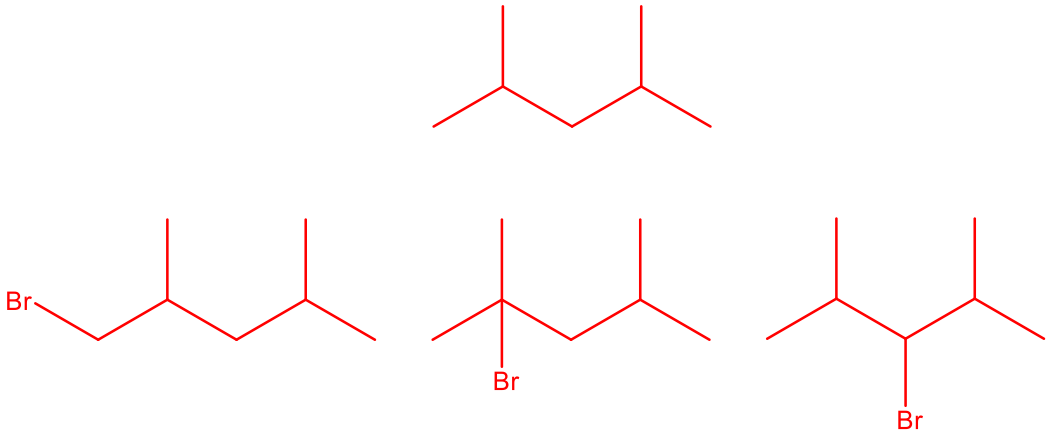
22 Alkanes can undergo free radical substitution with liquid bromine to produce mono-substituted bromoalkanes.

Which row gives the correct number of mono-substituted bromoalkanes produced and their relative proportions when 2,4-dimethylpentane reacts with bromine?

	number of mono-substituted bromoalkanes	relative proportions
A	3	1 : 1 : 6
B	3	2 : 3 : 3
C	4	1 : 1 : 6 : 6
D	4	1 : 2 : 3 : 3

Ans: A

For free radical substitution of 2,4-dimethylpentane, there are only 3 possible products as the molecule is symmetrical.



To obtain the first product, mono-substitution of any 12 H on the four methyl groups can take place

To obtain the second product, mono-substitution of any of the 2 tertiary H can take place

To obtain the third product, mono-substitution of any of the 2 H on the same carbon can take place.

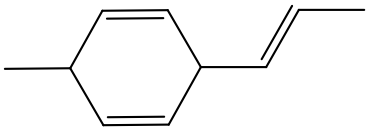
Hence the ratio is 12:2:2 or 6:1:1

23 Alkene **G** was heated with excess acidified $KMnO_4$ (aq). The resultant solution was cooled and separated into two test-tubes. Two reagents were added separately to each test-tube, with the observations recorded in the table below.

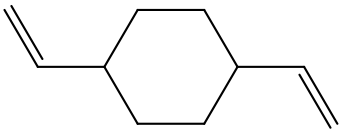
Reagent	Observations
$NaCO_3$	Effervescence. Gas evolved gave white precipitate with $Ca(OH)_2$ (aq)
2,4-DNPH	Orange precipitate formed.

What is the structure of alkene **G**?

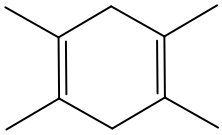
A



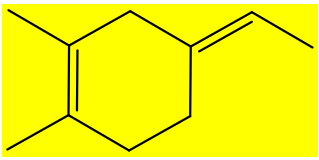
B



C



D



Ans: D

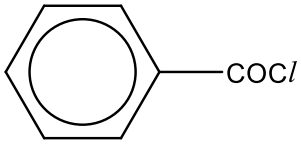
From the table of observations, the product of the oxidation of alkene **X** would yield a carboxylic acid and a carbonyl compound.

Option A and B would only carboxylic acids after oxidation

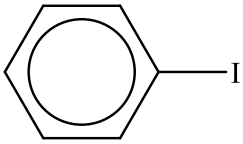
Option C would yield only ketones.

Option D would give both a ketone from the cyclic alkene and a carboxylic acid from rupturing of the side chain alkene.

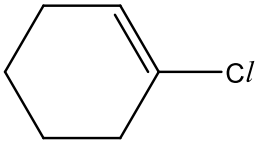
24 Equal amounts of **P**, **Q**, **R** and **S** are added separately to four test-tubes containing equal concentrations of ethanolic silver nitrate solution in a heated water bath.



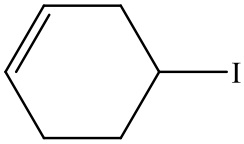
P



Q



R



S

Which option is correct?

	number of test-tubes with **no** precipitate	colour of the precipitate which forms the fastest
A	2	yellow
B	2	white
C	1	yellow
D	1	white

Ans: B

P, being an acid chloride, will give the Cl^- ion even in an aqueous medium almost immediately. Hence, the white AgCl will be the ppt seen the fastest and hence white.

25 Carbonyl compounds undergo nucleophilic addition reaction with HCN.

What is the hybridisation state of the reactive carbon in the organic reactant, intermediate and product during the reaction?

	Hybridisation state of carbon in		
	reactant	intermediate	product
A	sp^2	sp^2	sp^2
B	sp^2	sp^3	sp^2
C	sp^2	sp^3	sp^3
D	sp^3	sp^2	sp^3

Ans: C

The carbonyl carbon in reactant has only 3 sigma bonds. Hence its sp^2 hybridised. However, when it forms the anionic intermediate and cyanohydrin product, the C has 4 sigma bonds. Hence it is sp^3 hybridised.

26 Diester **T** has the molecular formula $C_7H_{12}O_4$.

One of the products from acid hydrolysis of **T** produces no effervescence when heated with acidified $KMnO_4$(aq).

Which of the following structures can be compound **T**?

A $CH_3CO_2CH_2CH_2OCOCH_2CH_3$

B $CH_3CH_2CO_2CH_2CO_2CH_2CH_3$

C $CH_3OCOCH_2CH_2CO_2CH_2CH_3$

D $CH_3CH_2OCOCH_2CO_2CH_2CH_3$

Ans: D

R	Products on acidic hydrolysis and oxidation with $KMnO_4$
$CH_3CO_2CH_2CH_2OCOCH_2CH_3$	CH_3COOH, CO_2 (oxidation of ethanedioic acid)
$CH_3CH_2CO_2CH_2CO_2CH_2CH_3$	CH_3CH_2COOH, CO_2 (oxidation of ethanedioic acid), CH_3COOH,
$CH_3OCOCH_2CH_2CO_2CH_2CH_3$	CO_2 (oxidation of methanol), $(HOOC)CH_2CH_2COOH$, CH_3COOH
$CH_3CH_2OCOCH_2CO_2CH_2CH_3$	CH_3COOH, $CH_2(COOH)_2$

27 The internal combustion engine catalytically removes harmful compounds.

Which statement about the catalytic removal of these compounds is **incorrect**?

A Carbon monoxide is oxidised

B Unburnt hydrocarbon is oxidised

C Water is produced.

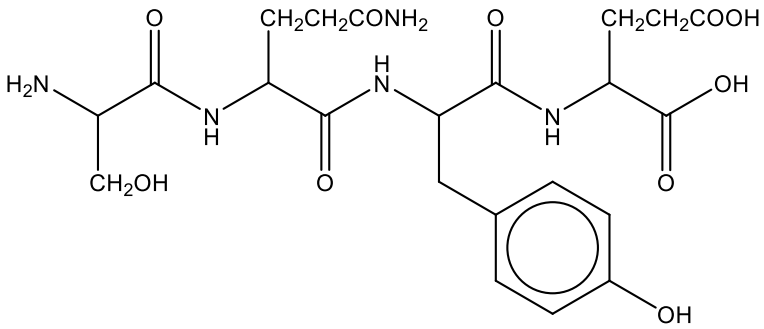
D Nitrogen dioxide is produced.

$2CO + O_2 \rightarrow 2CO_2$

$C_xH_y + (x+y/2)O_2 \rightarrow xCO_2 + (y/2)\ H_2O$

$2NO \rightarrow N_2 + O_2$

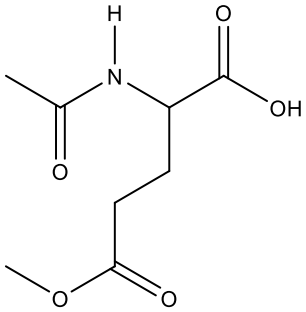
28 The diagram shows the structure of a tetrapeptide, **J**.



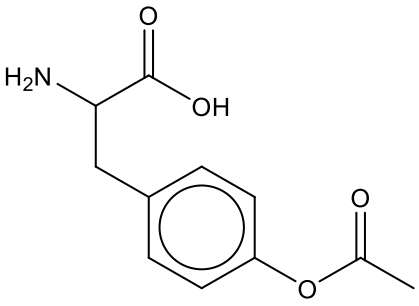
J is heated with aqueous NaOH under reflux, followed by careful acidification. Each product is isolated and warmed separately with excess ethanoyl chloride in an inert solvent, to produce compound **L**.

Which is a possible structure of **L**?

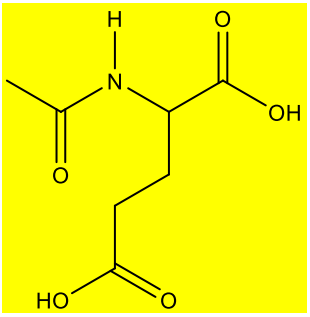
A



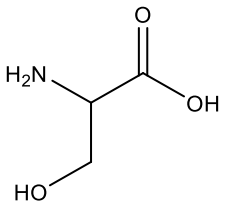
B



C

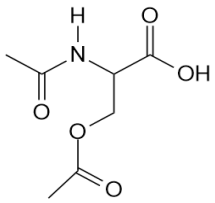
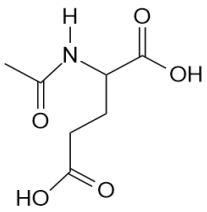
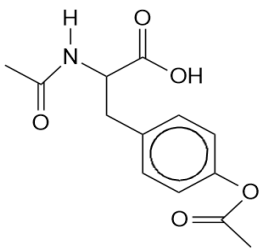
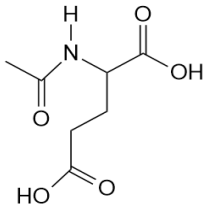


D



Ans: C

The following are the 4 possible products. With NaOH (aq) heat, the peptide bonds are hydrolysed. Subsequently with ethanoyl chloride, condensation takes place with amine, alcohol and phenol to form amide and esters respectively.

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

Which pair of compounds has d-block elements (Ti, V, Cr and Mn) with the same electronic configuration?

1 $TiCl_3$

2 $(NH_4)_3VO_4$

3 $Cr_2(SO_4)_3$

4 MnO_2

A 1 and 2

B 1 and 4

C 2 and 3

D 3 and 4

Ans: D

O.N of Ti in $TiCl_3$ is +3; Ti^{3+}: [Ar] $3d^1$

O.N of V in VO_4^{3-} is +3; V^{3+}: [Ar]

O.N of Cr in $Cr_2(SO_4)_3$ is +3; Cr^{3+}: [Ar]$3d^3$

O.N of Mn in MnO_2 is +4; Mn^{4+}: [Ar] $3d^3$

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

The half equation involved in the AgC*l* / Ag reference electrode is

$$AgCl + e^- \rightleftharpoons Ag + Cl^-$$

The reduction potential of V^{3+} / V^{2+} half-cell is –0.46 V when it is measured using the AgC*l* / Ag reference electrode at standard conditions.

What is the reduction potential of AgC*l* / Ag electrode when it is measured with the standard hydrogen electrode?

A +0.80V

B +0.20V

C –0.26V

D –0.76V

Ans: B

From the data booklet, the standard reduction potential of the V^{3+} / V^{2+} half-cell was found to be –0.26 V when measured with respect to the standard hydrogen electrode.

When measured with respect to the AgC*l* | Ag reference electrode, the reduction potential of the V^{3+} / V^{2+} half-cell was found to be –0.46 V. Hence the reduction potential of the AgC*l* | Ag electrode with respect to the standard hydrogen electrode is +0.20V.

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