Name:		Index Number:		Class:	

DUNMAN HIGH SCHOOL
Preliminary Examination 2019
Year 6

H2 CHEMISTRY 9729/01

Paper 1 Multiple Choice

30 September 2019
1 hour

Additional Materials: Data Booklet
Optical Mark Sheet

INSTRUCTIONS TO CANDIDATES

1 Write your **name**, **index number** and **class** on this question paper and the OTAS Mark Sheet.

2 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 Optical Mark Sheet.

3 Each correct answer will score one mark. A mark will not be deducted for wrong answer.

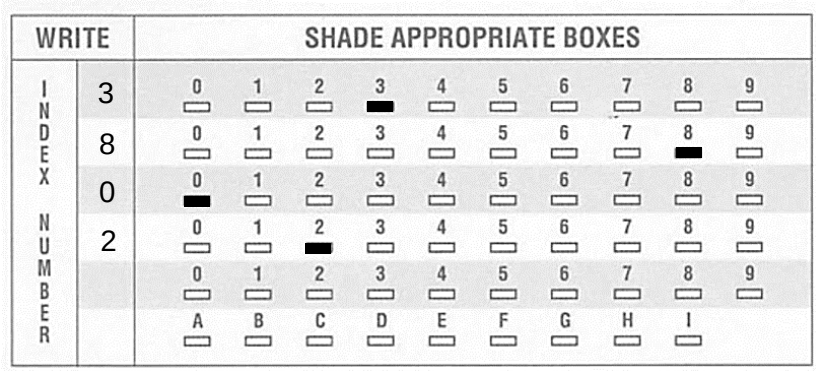
4 Any rough working should be done in this booklet.

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

6 On the OTAS Mark Sheet, please shade the code as "Class/Index number".

For illustration only:

A student from class 6C38, with index number 02, should shade "3802".



[Turn over

1 Sodium azide, NaN_3, and potassium nitrate, KNO_3, are both present in the airbags of some cars.

When the airbag is activated, sodium azide first decomposes to give sodium and nitrogen.

$$2NaN_3(s) \rightarrow 2Na(s) + 3N_2(g)$$

The sodium then reacts with potassium nitrate to produce more nitrogen.

$$10Na(s) + 2KNO_3(s) \rightarrow K_2O(s) + 5Na_2O(s) + N_2(g)$$

The nitrogen produced in these two reactions inflates the airbag.

2.00 mol of gas is needed to inflate the airbag.

What is the amount of sodium azide needed to inflate the airbag?

A 0.625 mol **B** 1.00 mol

C 1.25 mol **D** 1.33 mol

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

Sodium percarbonate, $(Na_2CO_3)_x \bullet y(H_2O_2)$ is an oxidising agent in some home and laundry cleaning products.

10.0 cm^3 of 0.100 mol dm^{-3} sodium percarbonate releases 48.0 cm^3 of carbon dioxide at room conditions on acidification.

An identical sample reacts with 24.0 cm^3 of 0.0500 mol dm^{-3} $KMnO_4$ before the first pink colour appears.

Given that $5H_2O_2 \equiv 2KMnO_4$, what is the ratio of $\frac{y}{x}$?

A $\frac{1}{3}$ **B** $\frac{2}{3}$

C $\frac{3}{2}$ **D** $\frac{3}{1}$

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

A compound is made up from two elements, **Y** and **Z**. Each separate atom of **Y** and of **Z** in their ground states has exactly 2 unpaired electrons.

What could the compound be?

1 $TiCl_4$

2 SiO_2

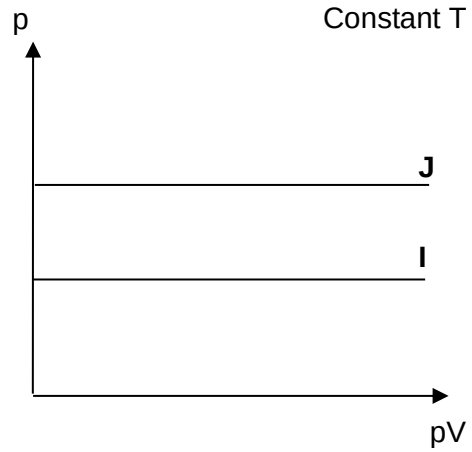
3 NiS

A 1, 2 and 3 **B** 2 and 3 only

C 1 and 3 only **D** 2 only

4 Which graph correctly describes the behaviour of fixed masses of the ideal gases **I** and **J**, where **I** has a higher M_r than **J**?

A



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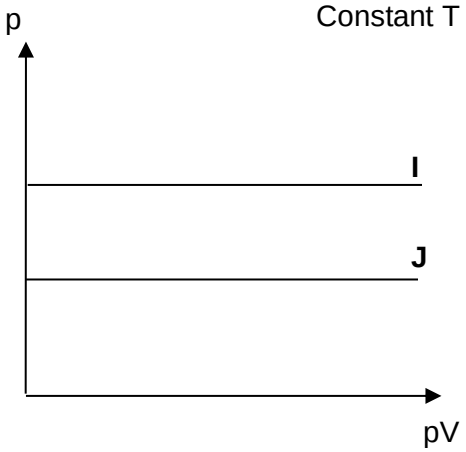

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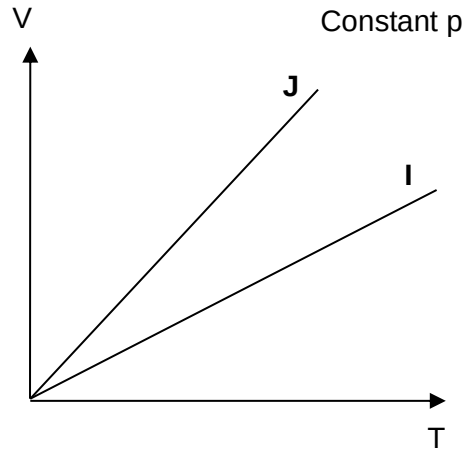

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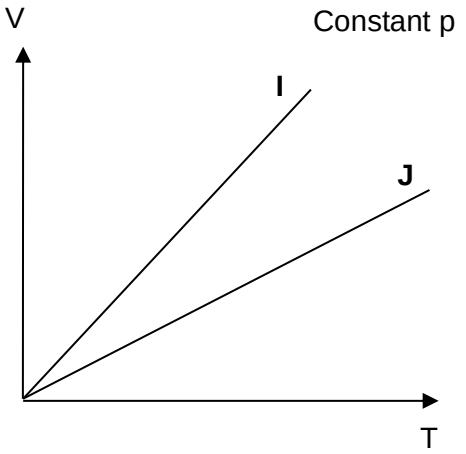


5 Which feature is present in the carbonate, ethanoate, nitrate and phenoxide ions?

A All bond angles are 120°

B Dative covalent bonds

C Delocalised electrons

D Hydrogen bonds

6 When an equilibrium is established in a reversible reaction, the standard Gibbs free energy, $\Delta G^{\ominus}$, is related to the equilibrium constant, K_c, by the following equation.

$$\Delta G^{\ominus} = - RT \ln K_c$$

where R is the gas constant and T is the temperature in Kelvin.

Which of the following statement is correct?

1 At constant temperature, a shift in position of equilibrium to the right results in the same value of $\Delta G^{\ominus}$.

2 The forward reaction is spontaneous for all values of K_c.

3 Adding a catalyst makes $\Delta G^{\ominus}$ more negative.

A 1, 2 and 3 only

B 2 and 3 only

C 1 and 3 only

D 1 only

7 Three equilibrium reactions are shown below. All three reactions have an equilibrium constant, K_c, that is greater than one.

$$N_2H_5^+ + NH_3 \rightleftharpoons NH_4^+ + N_2H_4$$
$$NH_3 + HBr \rightleftharpoons NH_4^+ + Br^-$$
$$N_2H_4 + HBr \rightleftharpoons N_2H_5^+ + Br^-$$

Assuming that all solutions have the same concentration, which correctly lists the three solutions in order of decreasing pH?

A $HBr > N_2H_5^+ > NH_4^+$

B $N_2H_5^+ > NH_4^+ > HBr$

C $NH_4^+ > N_2H_5^+ > HBr$

D $N_2H_5^+ > HBr > NH_4^+$

8 Which of the following resultant solutions will have the lowest pH?

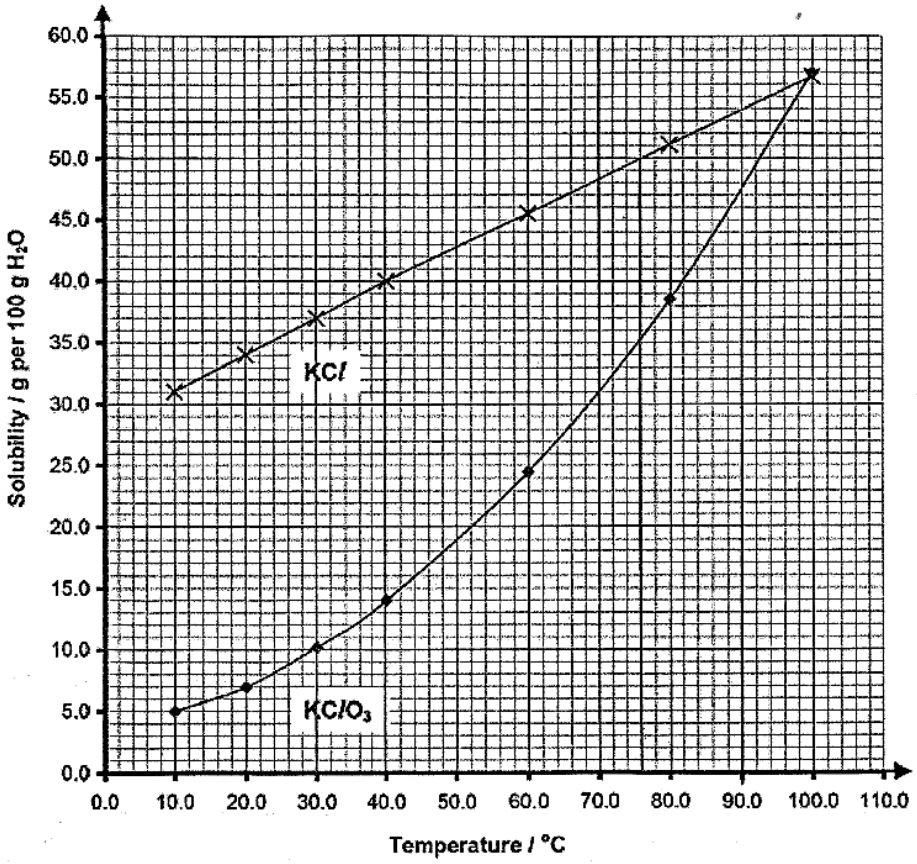
A 15 cm^3 of 0.100 mol dm^{-3} KOH added to 15 cm^3 of 0.050 mol dm^{-3} benzoic acid

B 50 cm^3 of 0.050 mol dm^{-3} KOH added to 25 cm^3 of 0.100 mol dm^{-3} benzoic acid

C 25 cm^3 of 0.100 mol dm^{-3} KOH added to 50 cm^3 of 0.100 mol dm^{-3} benzoic acid

D 5 cm^3 of 0.100 mol dm^{-3} KOH added to 50 cm^3 of 0.100 mol dm^{-3} benzoic acid

9 The graph below shows how the solubility of two salts, $KClO_3$ and KCl, varies with temperature.



10 g of $KClO_3$ and 50 g of KCl was added to 100 g of water at 90 °C.

Which statement is correct as the mixture is cooled to 10 °C?

1 The first trace of precipitate occurs at about 76 °C.

2 The aqueous solution is saturated with $KClO_3$ and KCl at 10 °C.

3 The maximum mass of KCl that can be precipitated without any trace of solid $KClO_3$ is approximately 13 g.

A 1, 2 and 3

B 2 and 3 only

C 1 and 2 only

D 3 only

10 Hydrazine, N_2H_4, used in rocket fuels can be obtained by the reaction of ammonia and hydrogen peroxide according to the following equation.

$$2NH_3(g) + H_2O_2(l) \rightarrow N_2H_4(l) + 2H_2O(l) \qquad \Delta H_{reaction}^{\ominus} = -241 \text{ kJ mol}^{-1}$$

Using the value of $\Delta H_{reaction}^{\ominus}$ given above and the data below, calculate the $\Delta H^{\ominus}$ (in kJ mol^{-1}) for decomposition of hydrazine into $N_2(g)$ and $H_2(g)$.

compound	$\Delta H_f^{\ominus}$ / kJ mol^{-1}
$NH_3(g)$	–46
$H_2O_2(l)$	–188
$H_2O(l)$	–286

A +189 **B** +51

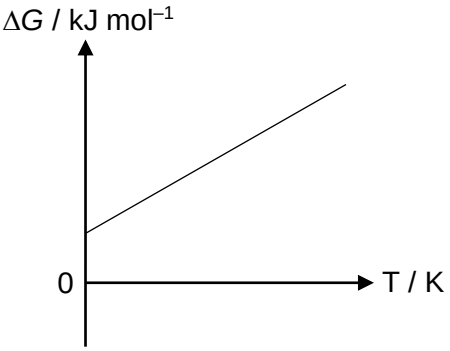
C –189 **D** –51

11 Methanol can be synthesised from carbon monoxide and hydrogen according to the equation

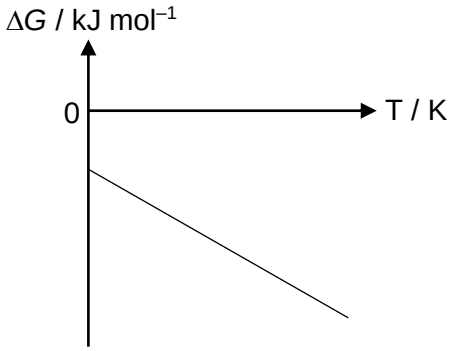
$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

Higher yield of methanol can be achieved at a lower temperature. Which graph corresponds to the forward process?

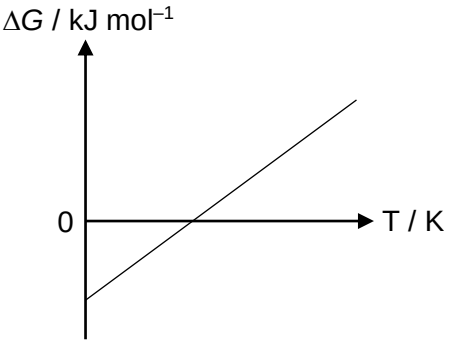
A



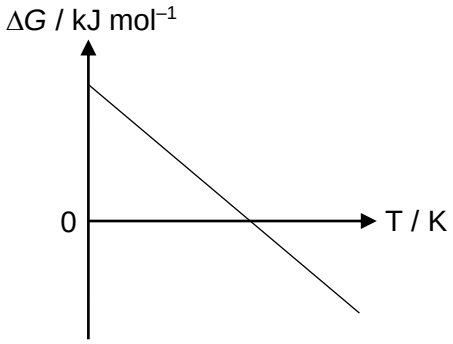
B



C



D



12 The table below shows the results of three experiments conducted for the following reaction.

$$\mathbf{P} + \mathbf{Q} \rightarrow \text{products}$$

experiment	[**P**] / mol dm^{-3}	[**Q**] / mol dm^{-3}	rate / mol dm^{-3} s^{-1}
1	0.012	0.005	1.0×10^{-4}
2	0.024	0.010	2.0×10^{-4}
3	0.048	0.010	4.0×10^{-4}

Another three experiments were carried out at different temperatures and the results obtained are shown below.

experiment	[**P**] / mol dm^{-3}	[**Q**] / mol dm^{-3}	temperature / ^{o}C
4	0.10	0.20	40
5	0.20	0.20	30
6	0.30	0.30	20

If the rate constant doubles for each 10 ^{o}C rise in temperature, which statements regarding experiments 4 to 6 are correct?

1 rate of reaction of experiments 4 and 5 are the same.

2 rate of reaction of experiment 4 is two times faster than experiment 6.

3 rate of reaction of experiment 6 is the slowest.

A 1, 2 and 3

B 1 and 2 only

C 1 and 3 only

D 2 and 3 only

13 **X**, **Y** and **Z** are elements in Period 3 of the Periodic Table. The results of some experiments carried out with compounds of these elements are shown.

	X	**Y**	**Z**
result of reacting the oxide of the element with HC*l*(aq)	salt solution	salt solution	mixture of acids
result of adding the oxide of the element to $H_2O(l)$	no reaction	alkaline solution	acid solution
result of adding the chloride of the element to $H_2O(l)$	hydrolyses	dissolves	hydrolyses

What could be the identities of **X**, **Y** and **Z**?

	X	**Y**	**Z**
A	A*l*	P	S
B	A*l*	Na	P
C	Si	Mg	P
D	Si	Na	A*l*

14 The table shows the results of experiments in which the halogens, $\mathbf{K}_2$, $\mathbf{L}_2$ and $\mathbf{M}_2$ were added to separate aqueous solutions containing $\mathbf{K}^-$, $\mathbf{L}^-$ and $\mathbf{M}^-$ ions.

	$\mathbf{K}^-$ (aq)	$\mathbf{L}^-$ (aq)	$\mathbf{M}^-$ (aq)
$\mathbf{K}_2$	no reaction	$\mathbf{L}_2$ formed	no reaction
$\mathbf{L}_2$	no reaction	no reaction	no reaction
$\mathbf{M}_2$	$\mathbf{K}_2$ formed	$\mathbf{L}_2$ formed	no reaction

Which statements are correct?

1 When $\mathbf{L}_2$ reacts with thiosulfate ions, the oxidation state of sulfur increases the most compared to the reaction between $\mathbf{M}_2$ and thiosulfate ions.

2 $\mathbf{L}^-$(aq) forms a precipitate with aqueous silver nitrate that is insoluble in excess aqueous ammonia.

3 $\mathbf{K}^-$ and $\mathbf{M}^-$ solutions can be distinguished by adding hexane.

A 2 only

B 1 and 2 only

C 1 and 3 only

D 2 and 3 only

15 Which hydrocarbon, when reacted with chlorine in the presence of sunlight, will form a monochlorinated product which shows both *cis-trans* isomerism and enantiomerism?

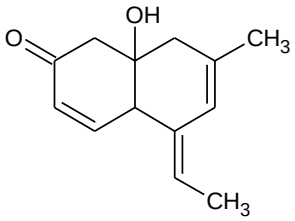
A $CH_3CH=CH_2$

B $(CH_3)_2C=CH_2$

C $CH_3CH=C(CH_3)_2$

D $CH_3CH=CHCH_2CH_3$

16 Which statement regarding compound **K** is correct?



Compound **K**

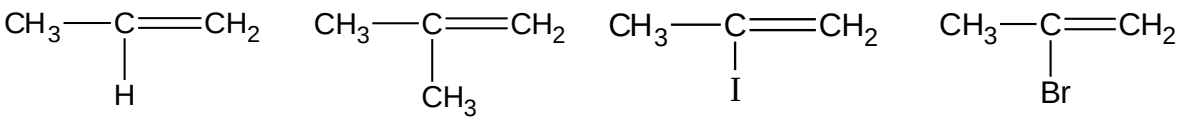
A 1 mol of **K** reacts with excess gaseous HBr to yield a major product with 7 chiral centres.

B 1 mol of **K** reacts with hot acidified $KMnO_4$ to give a dicarboxylic acid as one of the products.

C 1 mol of **K** reacts with 4 mol of H_2 in the presence of nickel catalyst to yield a saturated compound.

D 1 mol of **K** reacts with sodium to give 24.0 dm^3 of hydrogen gas at room temperature and pressure.

17 A comparison is made of the rate of electrophilic addition of Br_2 (in CCl_4) to the following compounds:



S **T** **U** **V**

How will the reaction rate vary for each compound?

	Fastest ⟶ Slowest			
A	**T**	**S**	**U**	**V**
B	**U**	**V**	**S**	**T**
C	**T**	**S**	**V**	**U**
D	**S**	**T**	**V**	**U**

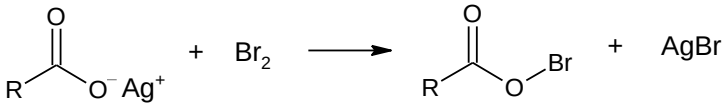
18 Consider all benzene-containing isomers with molecular formula C_9H_{10}.

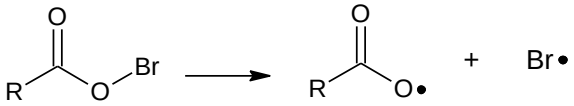
How many isomers will produce benzene-1,2-dicarboxylic acid on heating with acidified manganate(VII) ions?

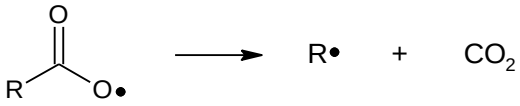
A 1 **B** 2

C 3 **D** 4

19 The Hunsdiecker reaction can be used to prepare alkyl bromides. Its mechanism is believed to involve the following steps.

step 1 

step 2 

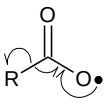
step 3 

step 4 

Which statement about the mechanism is correct?

1 RCO_2^- attacks the $\delta+$ bromine atom of Br_2 in step 1.

2 Homolytic fission of O–Br bond occurs in step 2.

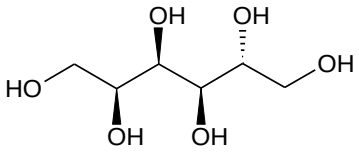
3 The curly arrows show the movement of electrons in step 3: 

4 Heat energy is absorbed in step 4.

A 1, 2 and 3 only **B** 2 and 3 only

C 1 and 4 only **D** 1 and 2 only

20 The structure of sorbitol is as shown.



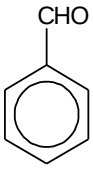
How many moles of gas is produced when one mole of sorbitol reacts with an excess of thionyl chloride, $SOCl_2$?

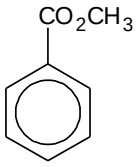
A 0 **B** 3

C 6 **D** 12

21 Compound **X** gives orange precipitate with 2,4–DNPH but does not react with Fehling's solution. When heated with alkaline aqueous iodine, **X** gives pale yellow precipitate.

What could compound **X** be?

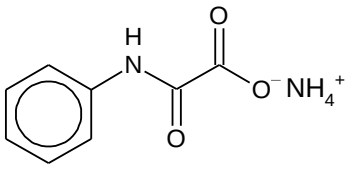
A 

B 

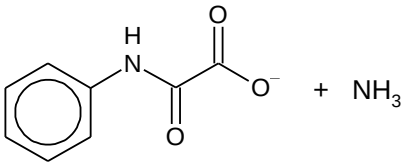
C $CH_3CH_2COCH_2CH_3$

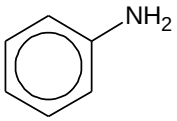
D $CH_3COCOCH_3$

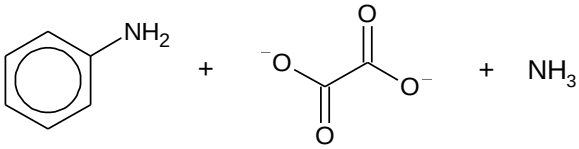
22 What are the products when ammonium N-phenyloxamate is heated with NaOH(aq)?

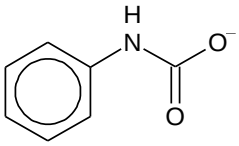


ammonium N-phenyloxamate

A  + NH_3

B  + CO_3^{2-} + NH_3

C  + NH_3

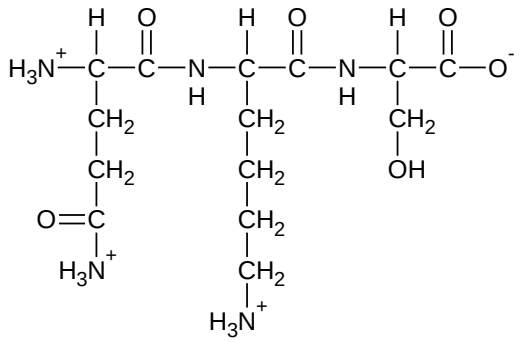
D  + CO_3^{2-} + NH_3

23 The table below shows three common amino acids in the human body.

Amino acid	3–letter abbreviation	Formula of side chain (R group)
Glutamine	*gln*	$-CH_2CH_2CONH_2$
Lysine	*lys*	$-CH_2CH_2CH_2CH_2NH_2$
Serine	*ser*	$-CH_2OH$

A tripeptide is formed from the three amino acids above. What is the structure of this tripeptide when hydrochloric acid is added to it at room temperature?

A



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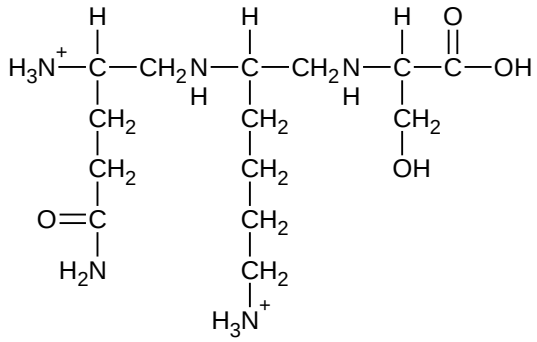

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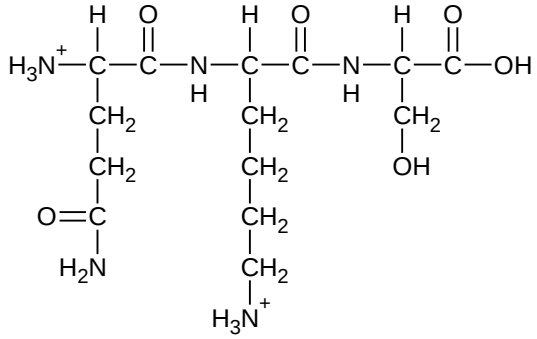
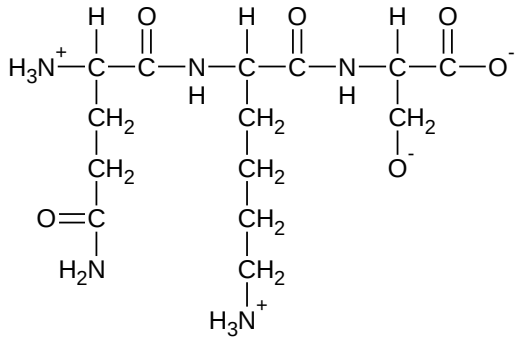
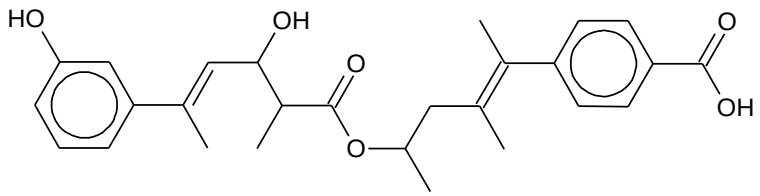


D



24 Which reagent and condition will **not** give an observable change with compound **Z**?



compound **Z**

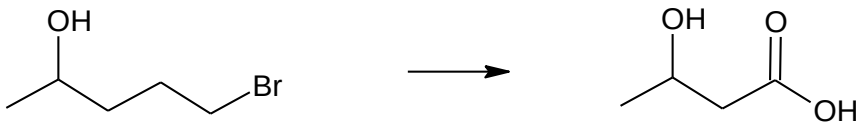
A Alkaline aqueous iodine, heat

B Anhydrous phosphorus pentachloride

C Lithium aluminium hydride in dry ether

D Cold dilute alkaline potassium manganate(VII)

25 Which sequence will achieve the conversion below?



	Step 1	Step 2	Step 3
A	NaOH(aq), heat	Hot acidified $KMnO_4$	H_2 gas, nickel catalyst, heat
B	Hot ethanolic KOH	Hot acidified $KMnO_4$	$NaBH_4$ in methanol
C	Hot acidified $KMnO_4$	KCN in ethanol, heat	H_2SO_4(aq), heat
D	Excess conc. H_2SO_4, heat	Hot acidified $KMnO_4$	Excess NaOH(aq), heat

Use of the Data Booklet is relevant to questions 26 – 29.

26 When a dilute $\mathbf{X}(NO_3)_2$ solution undergoes electrolysis, the metal **X** and gas **Y** are produced at the cathode and the anode respectively.

What could be the identities of metal **X** and gas **Y**?

	X	**Y**
A	Cu	NO_2
B	Fe	NO_2
C	Mg	O_2
D	Zn	O_2

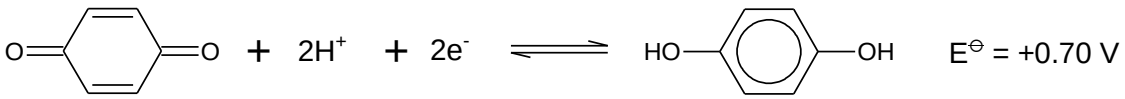
27 Zinc plating is frequently used to protect metals such as iron from corrosion.

A piece of iron was immersed into a solution of zinc nitrate and a current of 0.5 A was passed through it. How many minutes must the piece of iron be immersed in the solution to achieve an electroplated coating that weighs 0.4 g?

A 46.1 **B** 39.3

C 19.7 **D** 9.8

28 Quinone can be formed by oxidising quinol.



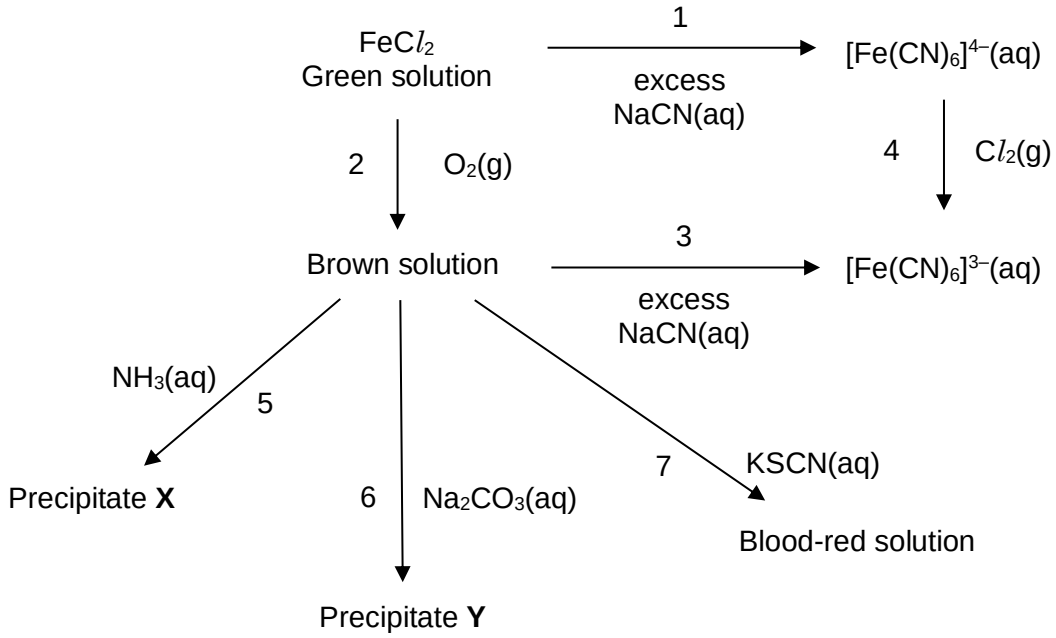
Quinone Quinol

Which aqueous reagent will give a good yield of quinone when added to quinol?

A H_2O_2 / H^+ **B** Br_2

C Cu^{2+} **D** $NaCl$

29 The following reaction scheme shows the chemistry of some iron-containing species in aqueous solution.



Which statement is **false** regarding the reaction scheme above?

A Precipitates **X** and **Y** are different compounds.

B A ligand exchange reaction happens in step 7.

C A redox reaction happens in step 2.

D The $E^{\ominus}_{cell}$ for step 4 is +1.00 V.

30 **M**$(H_2O)_xCl_y$ is an ionic compound which contains a metal complex cation, where ***x*** and ***y*** are integers.

When excess $AgNO_3$(aq) was added to 1 mol of aqueous **M**$(H_2O)_xCl_y$, 2 mol of $AgCl$ was precipitated. What is the possible identity of the complex cation?

A $[\mathbf{M}(H_2O)_6]^{3+}$

B $[\mathbf{M}(H_2O)_5Cl]^{2+}$

C $[\mathbf{M}(H_2O)_4Cl_2]^{+}$

D $[\mathbf{M}(H_2O)_2Cl_4]^{+}$