



JURONG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 2

CHEMISTRY

9746/01

Paper 1 Multiple Choice

28 August 2009

1 hour

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.

Write your name, class and shade your exam number on the Answer Sheet in the spaces provided.

There are **forty** 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.

Read the instructions on the Answer Sheet very carefully.

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.

A Data Booklet is provided. Do not write anything on the *Data Booklet*.

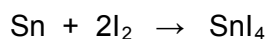
SECTION A (30 MARKS)

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

1. 0.904 g of $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot d\text{H}_2\text{O}$ was weighed and heated to drive off the water of crystallisation. The mass of the residue obtained was 0.774 g. Calculate the value of ***d*** in $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot d\text{H}_2\text{O}$.

- A** 1
- B** 2
- C** 3
- D** 6

2. Tin(IV) iodide can be prepared by refluxing 0.04 mol of tin with 0.03 mol of iodine (I_2) dissolved in 50 cm³ of tetrachloromethane (boiling point 77 °C).



Orange crystals of the product are obtained by filtering the hot reaction mixture and then cooling the filtrate.

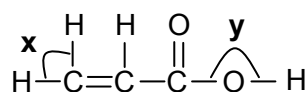
What would indicate that the reaction was complete?

- A** The boiling point of the mixture is 77 °C.
 - B** No tin remains in the reaction flask.
 - C** Crystals begin to be deposited from the boiling solvent.
 - D** No more purple vapour is seen in the reaction vessel.
3. It was believed that the bombardment of polonium atoms, Po, with atoms of an isotope of a Group III element, **X**, may bring about a new element with proton number 115 via the following reaction. Suggest the identity of **X**.



- A** Aluminium
- B** Gallium
- C** Indium
- D** Thallium

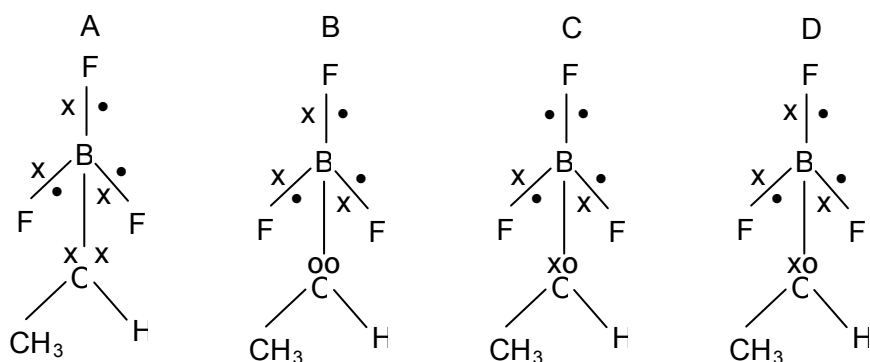
4. Two vessels containing 4 dm^3 of argon and 0.01 m^3 of water vapour respectively at 150°C and 101 kPa were connected together. The connected vessels were allowed to cool to room temperature. What was the final pressure in the connected vessel?
- A 4.18 kPa
B 16.8 kPa
C 20.3 kPa
D 71.2 kPa
5. The structure of propenoic acid is shown below.



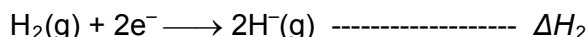
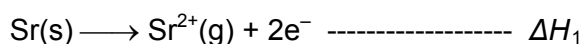
Which of the following statements is **incorrect** about the structure?

- A There are 8 σ bonds and 2 π bonds in the molecule.
B All the carbon atoms lie on the same plane.
C Bond angle x and y are 120° and 105° respectively
D All the carbon atoms are sp^3 hybridised.
6. $\text{BF}_3 \cdot \text{CH}_3\text{OH}$ is a reagent used to form methyl esters from compounds containing acyl groups. In the diagrams below, x , $\bullet$ and o represent electrons from B, F and O, respectively.

Which tetrahedral structure illustrates the electron pairs around the boron atom?



7. Strontium hydride is an ionic compound. The standard enthalpy changes, ΔH_1 and ΔH_2 are known.



What additional data is needed to determine the lattice energy of strontium hydride?

- A The first ionisation energy of hydrogen.
 - B The standard enthalpy change of atomisation of hydrogen.
 - C The standard enthalpy change of atomisation of strontium.
 - D The standard enthalpy change of formation of strontium hydride.
8. When 13.1 g (0.2 mol) of zinc dust was added to 250 cm³ of 1.0 mol dm⁻³ aqueous copper(II) sulphate (an excess), the temperature of the solution rose by 15 °C. The specific heat capacity of the solution is 4.20 J g⁻¹ K⁻¹.

What is the enthalpy change for the reaction $\text{Cu}^{2+} + \text{Zn} \rightarrow \text{Zn}^{2+} + \text{Cu}$?

- A -78.8 kJ mol⁻¹
 - B -4.13 kJ mol⁻¹
 - C +4.13 kJ mol⁻¹
 - D +78.8 kJ mol⁻¹
9. Given that
- $$\text{A}_2(\text{g}) + 4\text{C}(\text{g}) \rightleftharpoons 2\text{AC}_2(\text{g}) \quad K_c = 4.8 \text{ (numerical value)}$$
- it follows that, for the reaction,
- $$\text{AC}_2(\text{g}) \rightleftharpoons \frac{1}{2}\text{A}_2(\text{g}) + 2\text{C}(\text{g}) \quad K_c = \text{X (numerical value)}$$

X would be

- A $\frac{1}{4.8}$
- B $\frac{1}{2.4}$
- C 2.4
- D $\frac{1}{\sqrt{4.8}}$

10. What is the resultant pH when equal volumes of a solution of pH 1.0 and pH 3.0 are added together?

A 1.3
B 1.5
C 2.0
D 2.5

11. A solution, saturated with Ca(OH)_2 and CaSO_4 , has a pH of 12.3. What is the concentration, in mol dm^{-3} , of SO_4^{2-} ions in the solution?

(K_{sp} value of $\text{Ca(OH)}_2 = 4.0 \times 10^{-5}$, K_{sp} value of $\text{CaSO}_4 = 2.5 \times 10^{-5}$)

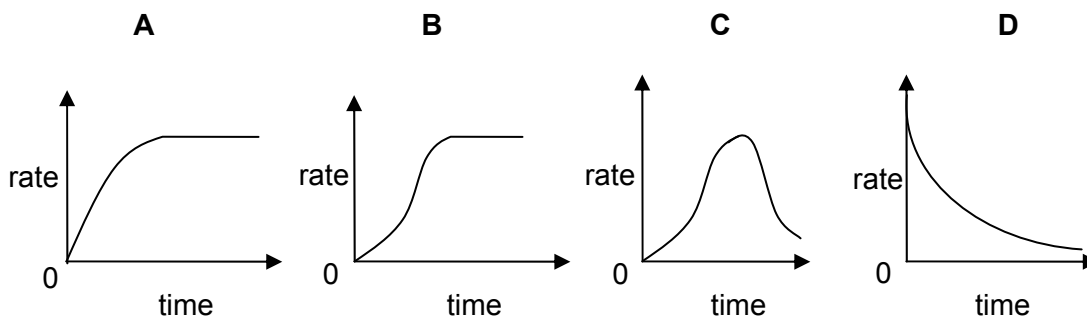
A 1.25×10^{-2}
B 2.50×10^{-2}
C 1.25×10^{-4}
D 2.50×10^{-4}

12. When a dilute sulfate solution of a metal J was electrolysed, the metal J and a diatomic gas K are produced at the cathode and anode respectively in the molar ratio 2:1. In another experiment, the same quantity of electricity is used to electrolyse a saturated sodium chloride solution and a gas L is evolved at the anode.

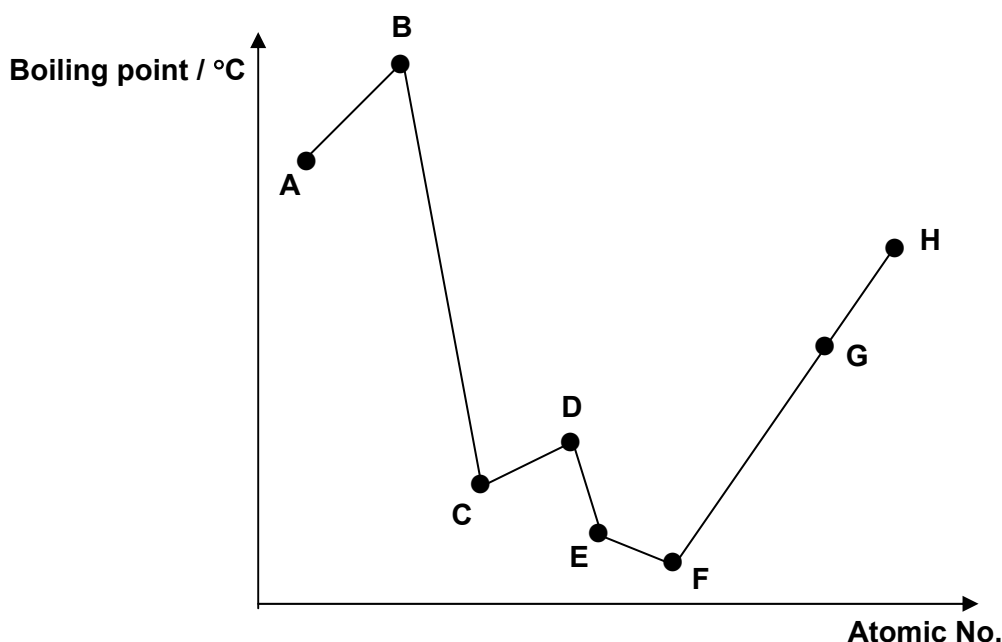
What is the molar ratio of J:K:L ?

A 4 : 2 : 1
B 4 : 2 : 3
C 2 : 1 : 1
D 2 : 1 : 2

13. Which curve is obtained if the rate of reaction is plotted against time for an autocatalytic reaction (i.e. a reaction in which one of the products catalyses the reaction)?



14. The graph below shows the variation in boiling point for 8 consecutive elements in the Periodic Table, all with atomic number ≤ 20 .



What can be deduced from the above?

- A Element **A** forms a chloride which exists as a dimer in the vapour phase.
 - B Element **D** is in the same group as nitrogen in the Periodic Table.
 - C Element **F** exists as diatomic molecules.
 - D Element **G** forms an oxide which is acidic in aqueous solution.
15. **P** and **Q** are hydroxy compounds of the elements **X** and **Y** respectively. **X** and **Y** are in the same period of the Periodic Table.

P gives an aqueous solution of $\text{pH} < 7$.

Q gives an aqueous solution which is strongly alkaline.

Which one of the following statements is true?

- A The atomic radius of **X** is greater than **Y**.
- B The first ionisation energy of **X** is smaller than **Y**.
- C The electronegativity of **X** is greater than **Y**.
- D The atomic number of **X** is smaller than **Y**.

16. How would the magnitude of the following vary down Group II?

- (i) the standard electrode potential of $M^{2+}(aq)/M(s)$ electrode, $E^\ominus$,
- (ii) the lattice energy of the oxide, $\Delta H^\ominus_{latt}$,
- (iii) the standard enthalpy change of hydration of $M^{2+}(g)$, $\Delta H^\ominus_{hyd}$.

	$E^\ominus_{M^{2+}/M}$	$\Delta H^\ominus_{latt}$ of $MO(s)$	$\Delta H^\ominus_{hyd}$ of $M^{2+}(g)$
A	increases	decreases	decreases
B	decreases	decreases	increases
C	increases	increases	decreases
D	increases	increases	increases

17. Which statement is true about the chemistry of sodium bromide?

- A** It is a much weaker reducing agent than sodium chloride.
- B** It reacts with iron(III) chloride solution to form a pale green solution.
- C** It liberates a red-brown gas on warming with concentrated sulphuric acid.
- D** It is formed together with sodium bromate(I) when bromine is bubbled into hot concentrated sodium hydroxide.

18. Transition metals like platinum and rhodium are found in catalytic converters fitted into cars. Which of the following statements best explains the role of transition metals in this use?

- A** Transition metals can exhibit variable oxidation states in their compounds as 3d and 4s electrons have similar energies.
- B** Transition metals form coloured ions due to absorption of energy in the visible light region to promote an electron from a lower to a higher energy 3d orbital.
- C** Transition metals have very high melting points because both 3d and 4s electrons are involved in forming strong metallic bond.
- D** Transition metals have available and partially filled 3d orbitals for adsorption of reactant molecules.

19. The use of the Data Booklet is relevant to this question.

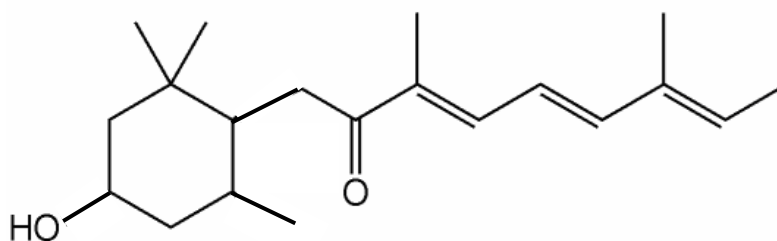
The colours of various vanadium ions in aqueous solution are given in the table below.

Oxidation state	V	IV	III	II
Ion	VO_2^+	VO^{2+}	V^{3+}	V^{2+}
Colour	yellow	blue	green	violet

What is the final colour of the solution when excess zinc powder is added to an acidified solution containing VO_2^+ ions?

- A Yellow
- B Blue
- C green
- D Violet

20. The structure of compound **X** is given below.

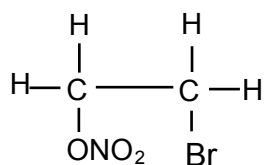


Compound X

How many **new** chiral centers will be formed when Compound **X** is completely hydrogenated over a nickel catalyst?

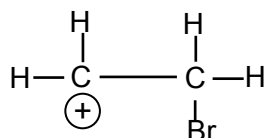
- A 2
- B 3
- C 6
- D 7

21. When ethene reacts with bromine in the presence of concentrated aqueous sodium nitrate, one of the products formed is given below.

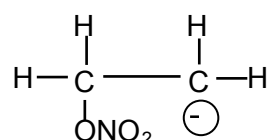


What is the intermediate formed in this reaction?

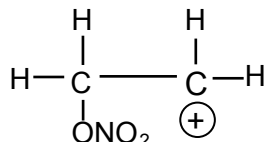
A



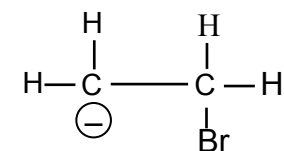
C



B



D



22. How many isomers (both structural and stereoisomers) are possible for an aromatic compound of molecular formula $\text{C}_8\text{H}_7\text{Cl}$?

- A** 4
B 5
C 6
D 7

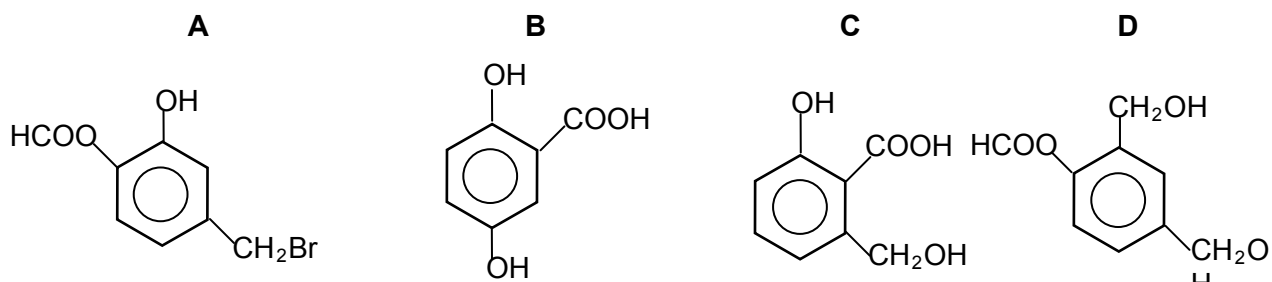
23. Bromine-containing organic compounds, **X**, **Y** and **Z**, are added to aqueous silver nitrate. The mass of cream precipitate formed is measured after some time.

Compound	Mass / g
X	0
Y	0.15
Z	1.05

Which of the following gives the correct structures for **X**, **Y** and **Z**?

- | | X | Y | Z |
|----------|---------------------------------------|---------------------------------------|---------------------------------------|
| A | $\text{BrCH}_2\text{CH}_2\text{Br}$ | $\text{C}_6\text{H}_5\text{Br}$ | $\text{BrCH}_2\text{CH}_2\text{COBr}$ |
| B | $\text{C}_6\text{H}_5\text{Br}$ | $\text{BrCH}_2\text{CH}_2\text{COBr}$ | $\text{BrCH}_2\text{CH}_2\text{Br}$ |
| C | $\text{C}_6\text{H}_5\text{Br}$ | $\text{BrCH}_2\text{CH}_2\text{Br}$ | $\text{BrCH}_2\text{CH}_2\text{COBr}$ |
| D | $\text{BrCH}_2\text{CH}_2\text{COBr}$ | $\text{BrCH}_2\text{CH}_2\text{Br}$ | $\text{C}_6\text{H}_5\text{Br}$ |

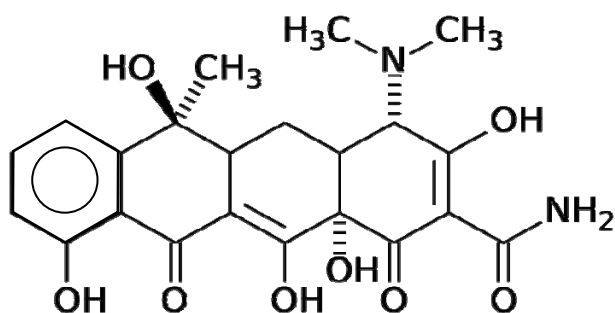
24. Which compound reacts with 2 moles of aqueous sodium hydroxide at room temperature?



25. Compound **X**, $C_6H_{12}O$, is oxidised by acidified sodium dichromate(VI) to compound **Y**. Compound **Y** reacts with ethanol in the presence of a little concentrated sulphuric acid to give liquid **Z**.

What is the formula of **Z**?

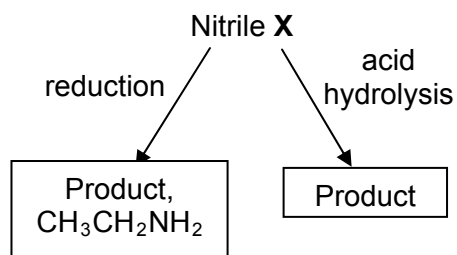
- A** $CH_3(CH_2)_2CH=CHCO_2H$
B $CH_3(CH_2)_4CH_2COCH_2CH_3$
C $CH_3(CH_2)_4CO_2CH_2CH_3$
D $CH_3CH_2CO_2(CH_2)_4CH_3$
26. The anti-bacterial drug *tetracycline* has the formula



tetracycline

Which statement about *tetracycline* is correct?

- A** It does not react with $SOCl_2$.
B It reacts with sodium carbonate to liberate carbon dioxide gas.
C 3 moles of HBr is formed when 1 mole of *tetracycline* reacts in an excess of aqueous bromine in the dark.
D It reacts with sodium metal to liberate H_2 gas.
27. A nitrile **X** undergoes the following two reactions:



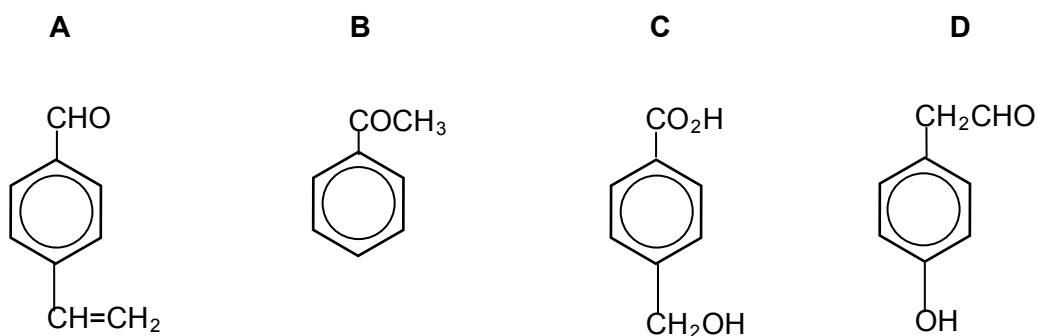
What would be produced when the products from the two reactions are mixed together?

- A** $[\text{CH}_3\text{CH}_2\text{NH}_3^+][\text{CH}_3\text{CH}_2\text{CO}_2^-]$
- B** $[\text{CH}_3\text{CH}_2\text{NH}_3^+][\text{CH}_3\text{CO}_2^-]$
- C** $\text{CH}_3\text{CONHCH}_2\text{CH}_3$
- D** $\text{CH}_3\text{CH}_2\text{CONHCH}_2\text{CH}_3$

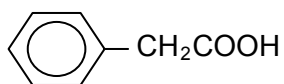
28. Compound **Q** was subjected to the following tests and the results are recorded below.

Reagents & Conditions	Observations
Acidified KMnO_4 , heat	Solution turns from purple to colourless. A gas is evolved.
Fehling's reagent, heat	No precipitate observed
Tollens' reagent, heat	Silver mirror observed

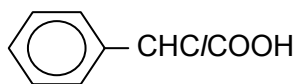
What could **Q** be?



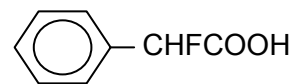
29. The structures of **P**, **Q** and **R** are shown below.



P



Q



R

When equal amounts of **P**, **Q** and **R** (not necessarily in that order) are added to separate portions of water, solutions with pH values of 2.5, 3.0 and 3.5 are formed.

Deduce which pH value is associated with each of the compounds **P**, **Q** and **R**.

	pH 2.5	pH 3.0	pH 3.5
A	Q	P	R
B	P	Q	R
C	R	Q	P
D	R	P	Q

30. Gastrins are heptadecapeptide (17 amino acid units) hormones that stimulate the secretion of gastric acid in the stomach of mammals. On hydrolysis of gastrins, the following four peptide fragments were isolated.

gly-trp
leu-glu-glu-glu-glu-ala-ala-try
glu-gly-pro-trp
met-asp-phe

C-terminus analysis of the heptadecapeptide yields a *phe* residue while N-terminus analysis yields a *glu* residue.

Based on the information above, suggest a primary structure for the heptadecapeptide and the number of peptide bonds it contains.

	Primary Structure	No. of peptide bonds
A	glu-gly-pro-trp-gly-trp-leu-glu-glu-glu-glu-ala-ala-try-met-asp-phe	17
B	glu-gly-pro-trp-gly-trp-leu-glu-glu-glu-glu-ala-ala-try-met-asp-phe	16
C	phe-asp-met-gly-trp-leu-glu-glu-glu-glu-ala-ala-try-trp-pro-gly-glu	16
D	phe-asp-met-gly-trp-leu-glu-glu-glu-glu-ala-ala-try-trp-pro-gly-glu	17

SECTION B (10 MARKS)

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.

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.

31. Which of the following changes can be regarded as oxidation of bromine?

- 1** $\text{Br}_2 \rightarrow \text{BrO}^-$
- 2** $\text{Br}_2 \rightarrow \text{BrF}$
- 3** $\text{Br}_2 \rightarrow \text{BrI}$

32. Boron nitride is formed by the direct combination between boron and nitrogen when heated. It has a structure similar to graphite. It is likely to be

- 1** a conductor of electricity
- 2** a lubricant
- 3** very hard

33. The radius and charge of six ions are given below.

Ion	J⁺	L⁺	M²⁺	X⁻	Y⁻	Z²⁻
Radius /nm	0.14	0.18	0.15	0.14	0.18	0.15

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

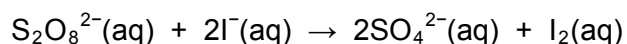
Which of the following statements are correct?

- 1** The melting point of **JX** is higher than that of **LY**.
- 2** The numerical value of the lattice energy of **MZ** is greater than that of **JX**.
- 3** The numerical value of the hydration energy of **J⁺** is smaller than that of **M²⁺**.

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

34. *The use of the Data Booklet is relevant to this question.*

An example of a reaction catalysed by transition metal ions is given below:



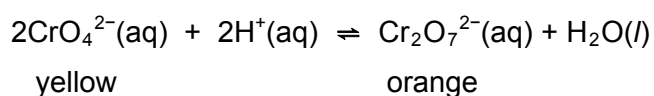
The $E^\ominus$ values for the half-reactions are:

$$E^\ominus, (\text{I}_2 / \text{I}^-) = +0.54 \text{ V}$$

$$E^\ominus, (\text{S}_2\text{O}_8^{2-} / \text{SO}_4^{2-}) = +2.01 \text{ V}$$

Which of the following transition metal ions can be used to catalyse this reaction?

- 1 Fe^{3+}
 - 2 Co^{3+}
 - 3 V^{3+}
35. Which of the following statements about the halogens (X_2) chlorine, bromine and iodine are correct?
- 1 The volatility of the halogens decreases down the group.
 - 2 The bond energies of the X-X bond decreases down the group.
 - 3 The electron affinity of the halogens decreases down the group.
36. The conversion of $\text{CrO}_4^{2-}(\text{aq})$ into $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$ is represented by the following equation.

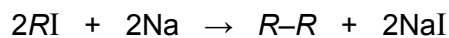


Which statements are true of this reaction?

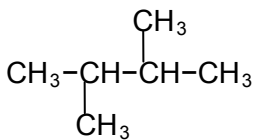
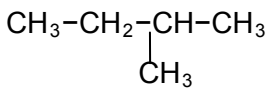
- 1 Addition of $\text{OH}^-(\text{aq})$ to $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$ causes a change in colour.
- 2 $\text{CrO}_4^{2-}(\text{aq})$ acts as a base.
- 3 The conversion of $\text{CrO}_4^{2-}(\text{aq})$ to $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$ is a redox reaction.

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

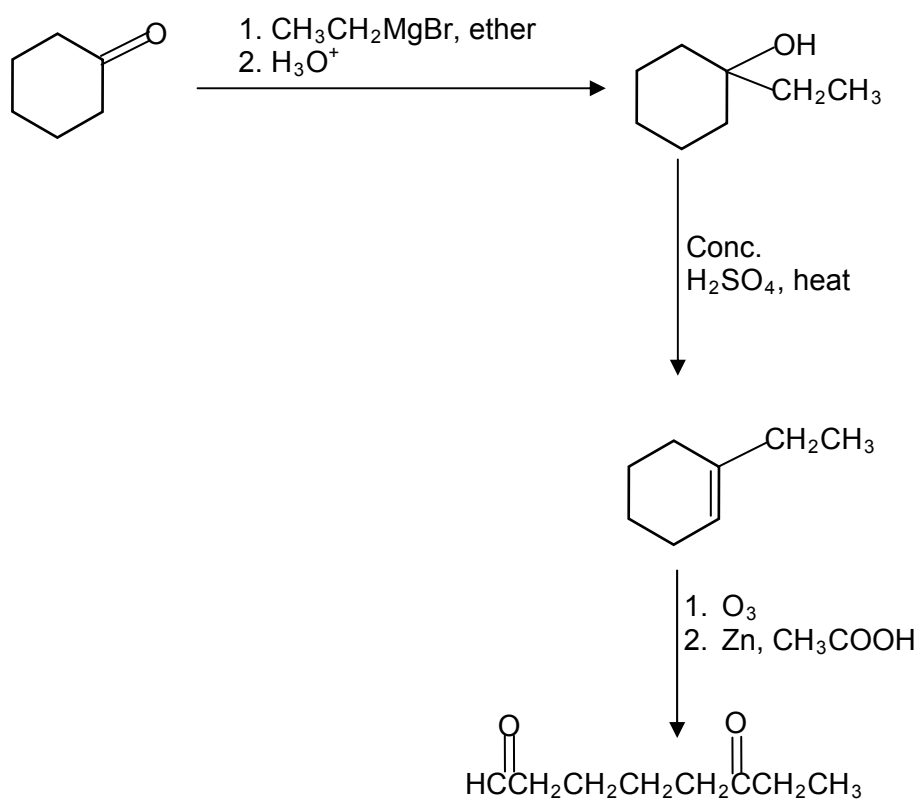
37. Alkanes can be prepared from iodoalkanes by heating under reflux with sodium (in ether) according to the equation:



Which alkanes will be produced if a mixture containing equal amounts of $\text{CH}_3\text{CH}_2\text{I}$ (iodoethane) and $\text{CH}_3\text{CHICH}_3$ (2-iodopropane) is used?

- 1 
- 2 
- 3 $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_3$

38.



Based on the information given in the reaction scheme above, which of the following reaction is involved?

- 1 nucleophilic addition
- 2 dehydration
- 3 oxidation

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

39. Serine is an amino acid commonly found in human body. Its structural formula is $\text{CH}_2\text{OHCH}(\text{NH}_2)\text{CO}_2\text{H}$.

Which of the following statements about serine are correct?

- 1 In a buffer solution of pH 9, serine is attracted towards the anode when a potential difference is applied.
- 2 In a polypeptide, the hydroxyl group of serine maintains the secondary structure by forming hydrogen bonds with polar R groups of other amino acid residues.

- 3 The zwitterionic form of serine is $\text{H}_3\text{N}^+-\text{C}(\text{H})(\text{CH}_2\text{O}^-)\text{COO}^-$

40. Which statements about methylamine, dimethylamine and trimethylamine are **incorrect**?

Compound	$\text{p}K_{\text{b}}$
CH_3NH_2	3.36
$(\text{CH}_3)_2\text{NH}$	3.29
$(\text{CH}_3)_3\text{N}$	4.28

- 1 They are trigonal planar with respect to the nitrogen atom.
- 2 They all form amides with ethanoyl chloride.
- 3 Trimethylamine is a weaker base than dimethylamine due to the steric hindrance which decreases the chances of protonation.