

CHEMISTRY

9647/01

Paper 1 Multiple Choice

Wednesday	19 ^m September 2012	1 hour
Candidates answer on	separate paper.	
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, Civics Group and index number on the Answer Sheet in the spaces provided unless this has been done for you.

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.

This document consists of **17** printed pages and **1** blank page

9647/01/TJC Prelim 2012

Section A

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

- 1 If a mixture of 0.4 g hydrogen and 9.6 g oxygen is exploded, what will be the volume of the remaining gas at room temperature and pressure?
 - **A** 0.60 dm³ **B** 1.20 dm³ **C** 2.40 dm³ **D** 4.80 dm³
- 2 Which of the following contains two isoelectronic species?
 - **A** NH_4^+ and BH_3
 - **B** NH₄⁺ and CH₄
 - **C** BF₃ and NH₃
 - **D** PF_5 and BF_4^-
- **3** For a given mass of an ideal gas, which of the following graphs display a different shape from the rest?
 - **A** PV against V (at constant T)
 - **B** V/T against T (at constant P)
 - **C** 1/density against T (at constant P)
 - **D** PV against P (at constant T)
- 4 25.0 cm³ of 0.0200 mol dm⁻³ of yellow **FA1** solution reacts with **x** g of zinc and the latter is oxidised to Zn²⁺. The resulting solution required 15.0 cm³ of 0.0200 mol dm⁻³ of acidified KMnO₄ to restore its original colour. Find **x**.
 - **A** 0.0196 g
 - **B** 0.0218 g
 - **C** 0.0327 g
 - **D** 0.0491 g

5 An aqueous sample containing the following anions is analysed.

$$Cl^{-}$$
 CO_{3}^{2-} SO_{4}^{2-}

In which order should the reagents be added to determine the amount of chloride in the sample?

[If a precipitate is formed, filtration process is carried out before the addition of the next reagent to the filtrate.]

	Reagent 1	Reagent 2	Reagent 3
Α	AgNO ₃	HNO ₃	Ba(NO ₃) ₂
В	HNO ₃	Pb(NO ₃) ₂	AgNO ₃
С	HNO ₃	Ba(NO ₃) ₂	AgNO ₃
D	Ba(NO ₃) ₂	NH ₃	AgNO₃

6 The successive ionisation energies (IE) of two elements **X** and **Y**, are given below:

IE/ kJ mol-1	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th
X	786	1580	3230	4360	16000	20000	23600	29100
Y	1251	2298	3822	5158	6542	9330	11000	33604

The compound formed when X and Y combine is most likely to be

- **A** ionic, with formula X_2Y
- **B** ionic, with formula **XY**₂
- **C** covalent, with formula **XY**₄
- **D** covalent, with formula X_2Y_5

7 The reaction between phosphorus and hydrogen can result in the formation of phosphine as shown:

 $P_4(s) + 6H_2(g) - 4PH_3(g)$

The graph shows the change in concentration of hydrogen for this reaction in which the system was disturbed after four hours.



Time / hours

Which of the following could explain the change in the hydrogen concentration at time, t = 4 hours?

- A The volume of the reaction vessel was decreased.
- **B** A catalyst was added.
- **C** The pressure on the reaction mixture was decreased.
- **D** More phosphorus was added.

8 If compound **A** is heated, it decomposes according to the equation:

 $2\mathbf{A}(g) \longrightarrow \mathbf{B}(g) + \mathbf{C}(g)$

The following diagram shows the progress of the reaction.



9 In a blast furnace, carbon or carbon monoxide can be used to reduce iron(III) oxide. $Fe_2O_3(s) + \frac{3}{2}C(s) \rightarrow 2Fe(s) + \frac{3}{2}CO_2(g) \qquad \Delta H = +234 \text{ kJ mol}^{-1}$

 $Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$ $\Delta H = -24.8 \text{ kJ mol}^{-1}$

Carbon monoxide can be formed by the following reaction.

 $C(s) + CO_2(g) \rightarrow 2CO(g) \qquad \Delta H_1$ What is the value of ΔH_1 ?

A +86.3 kJ mol⁻¹

- **B** +139.5 kJ mol⁻¹
- C +172.5 kJ mol⁻¹
- **D** +258.8 kJ mol⁻¹
- 10 Which of the following reactions shows a positive change in entropy? [Assume that all measurements are taken at 298 K and 1 atm pressure.]
 - **A** $N_2O(g) \ge N_2(g) + \frac{1}{2}O_2(g)$
 - **B** $Fe(s) + S(s) \stackrel{>}{a} FeS(s)$
 - **C** $Ca(s) + \frac{1}{2}O_2(g)$ **a**CaO(s)
 - **D** $C_3H_6(g) + H_2(g)$ **à** $C_3H_8(g)$

- **11** Car manufacturers are developing engines that use H₂ as a fuel. Approximately 5% of industrial hydrogen is produced by electrolysis of water. How many coulombs are needed to produce 1.02 ⁻ 10⁶ mol of H₂ gas?
 - A 1.02 ′ 10⁶ C
 - **B** 9.84 ′ 10¹⁰ C
 - **C** 1.97 ′ 10¹¹ C
 - **D** 1.97 ′ 10¹⁴ C
- **12** Ethyl ethanoate undergoes a slow acid-catalysed hydrolysis in water where the concentration of acid in the solution remains constant.

 H^+ CH₃CO₂CH₂CH₃ + H₂O ® CH₃CO₂H + CH₃CH₂OH

The rate equation is found to be

rate =
$$k[CH_3CO_2CH_2CH_3][H^+]$$

When 0.1 mol dm⁻³ of HC*l* is reacted with 0.2 mol dm⁻³ of ethyl ethanoate, the half-life was found to be 62 min.

Another reaction was carried out with 0.2 mol dm⁻³ of HC*l* and 0.2 mol dm⁻³ of ethyl ethanoate. How long does it take for the concentration of ethyl ethanoate to fall to 0.025 mol dm⁻³?

13 25 cm³ of 0.1 mol dm⁻³ monobasic acid X is titrated with 25 cm³ of 0.2 mol dm⁻³ NaOH. The end point cannot be detected using screened methyl orange.

Which of the following is not correct?

- A The solution acts as a buffer when 12.50 cm³ of NaOH has been added.
- **B** Initial pH of the solution is more than 1.00.
- **C** pH of the equivalence point is more than 7.
- **D** Acid **X** is a weak acid.

14 A 100 cm³ solution consists of 0.20 mol dm⁻³ MgC*l*₂ and 0.10 mol dm⁻³ CuC*l*₂. A solution of sodium hydroxide is added to the mixture. Mg(OH)₂ starts precipitating when 40 cm³ of sodium hydroxide has been added.

The solubility product values of Mg(OH)₂ and Cu(OH)₂ are 6.3 $\acute{}$ 10⁻¹⁰ and 2.2 $\acute{}$ 10⁻²⁰ respectively.

What is the concentration, in mol dm⁻³, of Cu^{2+} in the solution when Mg(OH)₂ just precipitates?

- **A** 4.99 ′ 10⁻¹²
- **B** 6.98 ′ 10⁻¹²
- **C** 6.60 ′ 10⁻⁵
- **D** 7.14 ′ 10⁻²
- **15** Which of the following graphs shows the correct trend in the physical property of the period 3 elements?



What is **W**?

- A NaNO₂
- B KI
- C MgCl₂
- D Ag₂CO₃
- 17 Which statement is true about the first row transition metals or their compounds?
 - **A** $[Ni(C_2O_4)_2(CN)_2]^{4-}$ has a coordination number of 4.
 - **B** Yellow CrO_4^{2-} is oxidised to orange $Cr_2O_7^{2-}$ in an acidic medium.
 - **C** Fe³⁺ is more stable in acidic than in alkaline medium.
 - **D** $Fe_2(CO_3)_3$ cannot be prepared by reacting $FeCl_3(aq)$ with $Na_2CO_3(aq)$.
- **18** Transition metals like nickel are used in the manufacture of margarine. Which of the following statements best explains the role of transition metals in this use?
 - A Transition metals have very high melting points because both 3d and 4s electrons are involved in forming strong metallic bond.
 - **B** Transition metals have partially filled 3d orbitals for adsorption of reactant molecules.
 - **C** Transition metals can exhibit variable oxidation states in their compounds as 3d and 4s electrons have similar energies.
 - **D** 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.
- 19 Which row in the table below has the correct number and type of bonds in

	Number of s - bonds	Number of p - bonds
Α	4	3
В	8	5
С	10	2
D	10	3

- **20** Pentane was reacted with limited bromine in the presence of *uv* light. Assuming that only monobromination took place and the reaction occurred at the same rate at all carbon atoms, the ratio of the 3 possible products, 1-bromopentane : 2-bromopentane : 3-bromopentane is
 - **A** 3:2:1
 - **B** 1:2:3
 - **C** 1: 3 : 2
 - **D** 3:1:2
- 21 Phenylethene undergoes the following reactions to form compound **A**.



Phenylethene

What is the structural formula of A?



22 The demand for 'natural' shampoos and detergents has led to the development of more biodegradable detergents such as sorbitan monolaurate, which is made from plants. Its structure is shown below.



Which statement is correct?

- A There will be no colour change on heating the compound with acidified potassium dichromate(VI) solution.
- **B** It is optically inactive.
- C It can react with concentrated sulfuric acid on heating.
- **D** It is a cyclic ester.
- **23** In which pair of molecules is the pK_a of molecule I bigger than that of molecule II?



compound	structural formula	C- H bond length /nm
methane	CH ₄	0.110
ethane	CH ₃ CH ₃	0.110
ethene	CH ₂ =CH ₂	0.108
ethyne	CH⁰CH	0.106

24 The C- H bond lengths of four hydrocarbons are given in the table below.

Which of the following helps to explain the shortest C-H bond length observed in ethyne?

- **A** Ethyne is a linear molecule.
- **B** The carbon orbital used in formation of the C- H bond in ethyne has the greatest s orbital character.
- **C** An sp-sp overlap is observed between the two carbon atoms in ethyne.
- **D** The carbon-carbon triple bond in ethyne is the strongest.
- **25** A drug containing a carboxyl group can bind to an amino group on a receptor site in three different ways.

Hydrogen-bond acceptor

Hydrogen-bond donor

c^{≠0}

Ionic interaction



Binding site



Binding site

Binding site

The drug with the following structure



could bind to the same site

- A only by ionic interaction
- **B** only as a hydrogen-bond donor
- **C** only as a hydrogen-bond acceptor
- **D** both as a hydrogen-bond donor and acceptor

26 The reduction of a nitrile **Q** produced a compound of the formula $CH_3CH_2NH_2$. The same nitrile **Q** was also hydrolysed separately in acidic medium.

What would be formed if the products from the two reactions are mixed together?

- A $(CH_3CH_2NH_3)(CH_3CO_2)$
- **B** $(CH_3CH_2NH_3)(CH_3CH_2CO_2^-)$
- **C** $CH_3CH_2CONHCH_2CH_3$
- D CH₃CONHCH₂CH₃
- 27 The reaction conditions for four different transformations are given.

Which transformation has the correct conditions?



28 Compound X has the following structure.



Which of the following statements is true for compound X?

- **A** It will give white fumes with SOC*l*₂.
- **B** It is insoluble in both aqueous acids and alkalis.
- **C** The nitrogen containing group in the ring has a higher pK_b than the nitrogen containing group in the side chain.
- **D** It contains a total of six sp² hybridised carbon atoms.
- 29 Compound Y is used to treat hypertension.



Compound Y

Which of the following statements about compound Y is true?

- A One mole of compound Y reacts with 3 moles of CH₃COC*l*.
- **B** One mole of compound **Y** reacts with 3 moles of NaOH on heating.
- C One mole of compound Y liberates 1 mole of hydrogen gas with Na metal.
- **D** Compound **Y** gives an orange precipitate with 2,4-dinitrophenylhydrazine.
- 30 Which statement about ammonia, methylamine and phenylamine is not correct?
 - A Basic strength in aqueous solution increases from phenylamine to ammonia to methylamine.
 - **B** All of them can act as nucleophiles using the lone pair on the nitrogen atom.
 - C All are trigonal pyramidal in shape with respect to the nitrogen atom.
 - **D** Only methylamine and phenylamine form white precipitate with aqueous bromine.

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	В	С	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 Chromate and dichromate ions form an equilibrium according to the following equation.

$$2CrO_4^{2-}(aq) + 2H^+(aq) \longrightarrow Cr_2O_7^{2-}(aq) + H_2O(I)$$

Which solution would increase the concentration of the chromate ion, CrO_4^{2-} , when added to the equilibrium mixture?

- **1** Sodium ethanoate
- 2 Ammonium chloride
- 3 Sodium nitrate
- 32 When metal **A** is placed in a solution of a salt of metal **B**, the surface of metal **A** changes colour. When metal **B** is placed in an acidic solution, gas bubbles forms on the surface of the metal. When metal **A** is placed in a solution of a salt of metal **C**, no change is observed.

Which of the following statements are correct?

- 1 When metal **B** is placed in a solution of silver nitrate, silver deposits can be formed.
- 2 The order of decreasing reducing strength is $C > A > B > H_2$.
- **3** H^+ is being oxidised to H_2 when metal **B** is placed in acidic solution.

The responses **A** to **D** should be selected on the basis of

A	В	С	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.

33 The table below shows the experimental results obtained for the following reaction.

partial pressure of YO (in arbitrary units)	100	100	50	25
partial pressure of O ₂ (in arbitrary units)	100	50	50	D
relative rate	1.00	0.50	0.25	1.00

Which of the following statements are correct?

- 1 The value of **D** is 400.
- 2 The reaction is first order with respect to YO.
- **3** Keeping partial pressure of YO constant, increasing partial pressure of O₂ does not change the relative rate.
- **34** Which combination of solutions would give a buffer solution?
 - 1 10 cm³ of 0.1 mol dm⁻³ CH₃CO₂H and 10 cm³ of 0.1 mol dm⁻³ CH₃CO₂Na.
 - **2** 10 cm³ of 0.1 mol dm⁻³ HCl and 20 cm³ of 0.1 mol dm⁻³ CH₃CO₂Na.
 - **3** 20 cm³ of 0.1 mol dm⁻³ HC*l* and 10 cm³ of 0.1 mol dm⁻³ Mg(CH₃CO₂)₂.
- **35** The enthalpy changes involved in the formation of KCl(aq) from K(s) and $Cl_2(g)$ are as follows:

Which statements are true?

- 1 The enthalpy change of solution of potassium chloride is $\Delta H_3 + \Delta H_4$.
- **2** The enthalpy change of formation of solid potassium chloride is $\Delta H_1 + \Delta H_2 + \Delta H_3$.
- **3** The lattice energy of potassium chloride is ΔH_3 .

The responses **A** to **D** should be selected on the basis of

A	В	С	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.

- 36 Beryllium resembles aluminium in its chemical properties.Which property of beryllium compounds is **not** correct?
 - **1** Beryllium chloride is an ionic compound.
 - **2** Beryllium chloride can form the dimer Be_2Cl_4 .
 - **3** Beryllium chloride dissolves in water to give an acidic solution.
- 37 Barium is an element in Group II. Which of the following statements are correct?
 - **1** Barium burns with apple green flame.
 - **2** $Ba(OH)_2$ has a higher solubility in water than $Mg(OH)_2$.
 - **3** Barium metal rapidly changes from silvery-white to dark grey colour in presence of air.
- **38** Chemists in the late 1800s knew that cyclic molecules existed, but the limitations on the ring sizes were unclear. Rings of all sizes from three to thirty and beyond can now be prepared easily.

Cyclopropane is known to be less stable than cyclohexane.





Cyclopropane

Cyclohexane

Which reasons explain the difference in stability?

- 1 The sp²-sp² overlap strengthens the carbon- carbon bonds in cyclohexane.
- 2 The C-C-C bond angle of cyclopropane experiences a larger deviation from the ideal value of 109.5°.
- **3** The carbon atoms of cyclohexane are not in the same plane, allowing bond angles to be near the ideal value.

The responses **A** to **D** should be selected on the basis of

A	В	С	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.

39 Polyethene is made by polymerization of ethene molecules via a free radical mechanism under high temperature and pressure, in the presence of an organic peroxide.

Chain initiation

organic peroxide

 $R \cdot + CH_2 = CH_2 \longrightarrow RCH_2CH_2 \cdot$

Chain propagation

 RCH_2CH_2 + $nCH_2=CH_2 \otimes R(CH_2CH_2)_nCH_2CH_2$

The chain process is eventually ended by combination of two radicals in the termination step.

Which of the following can be formed in the free radical mechanism?

- $1 \qquad [R(CH_2CH_2)_nCH_2CH_2]_2$
- $\begin{array}{c} \mathbf{2} \qquad \mathbf{0} \\ \parallel \\ \mathbf{R} \mathbf{C} \mathbf{O} \mathbf{C} \mathbf{H}_2 \mathbf{C} \mathbf{H}_2 \mathbf{\cdot} \end{array}$
- **3** R(CH₂CH₂)₂R
- **40** An amino acid has the structural formula HOCH₂CH(NH₂)CO₂H. Which of the following statements apply to this amino acid?
 - 1 In a buffer solution of pH 9, this amino acid is attracted towards the anode when a potential difference is applied.
 - 2 It is an α -amino acid which is optically active.
 - **3** In a polypeptide, the hydroxyl group of this amino acid maintains the secondary structure by forming ionic bonds with polar R groups of other amino acid residues.