CHEMISTRY **8872/01**
Higher 1

Paper 1 Multiple Choice

02 September 2015

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 fluids.
Write your name, index number and tutorial class on the Answer Sheet in the spaces provided unless this has been done for you.

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.

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

This document consists of **14** printed pages and **2** blank pages.

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© ACJC 2015   Department of Chemistry   **[Turn over**

Section A

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

1   Tetraarsenic trisulfide, As_4S_3 is used as a maintenance therapy for newly diagnosed acute leukemia. It reacts with oxygen to produce an oxide of arsenic in the +5 oxidation state and an oxide of sulfur in the +4 oxidation state.

   How many moles of oxygen gas are needed to burn **two** moles of As_4S_3?

   A   7.5

   B   8

   C   15

   D   16

2   In an experiment, 33.40 cm^3 of a 0.150 mol dm^{-3} solution of a metallic ion, M^{n+}, reacted exactly with 50.0 cm^3 of 0.050 mol dm^{-3} aqueous sodium sulfite.

   The half-equation for the oxidation of sulfite ion is shown below.
   $$SO_3^{2-} (aq) + H_2O (l) \rightarrow SO_4^{2-} (aq) + 2H^+ (aq) + 2e^-$$

   If the final oxidation number of the metal in the salt was +3, what would be the original oxidation number of the metal?

   A   +2

   B   +3

   C   +4

   D   +5

3   Titanium has the electronic structure, $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2\ 4s^2$.

   Which one of the following compound is **NOT likely** to exist?

   A   TiN

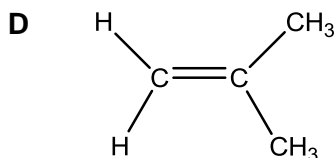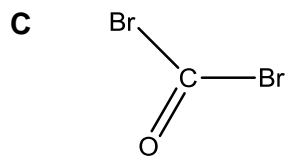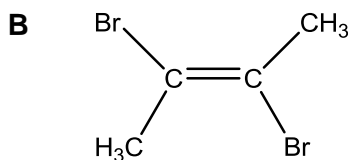   **B** $KTiO_4$

   C   TiS

   D Na_3TiF_6

4 The successive ionisation energies, in kJ mol^{-1}, of an element **X** are given below.

$$1010 \quad 2265 \quad 3662 \quad 4998 \quad 7002 \quad 8992 \quad 28698 \quad 32215$$

Which one of the following would best represent the formula of the ionic compound formed by **X**?

A **X**Br

B **X**O$_2$

C Mg**X**$_2$

D K$_2$**X**

5 Which molecule has the largest dipole?
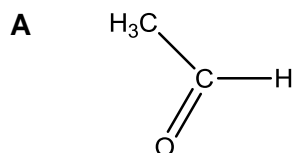
6 Which of the following pairs of substances have different types of bonding and structure?

A AsCl_3 AsCl_5

B AlF$_3$ AlCl_3

C P$_4$ PH$_3$

D Si SiO$_2$

7 Which of the following **cannot** be explained by hydrogen bonding?

A Ethanoic acid molecules form dimers in presence of benzene.

B Boiling point of alcohols increases with increasing Mr.

C Ice can float on frozen lake.

D Formation of HF$_2^-$.

8 A student weighed 4.20 g of solid sodium hydrogencarbonate, $NaHCO_3$ ($M_r = 84.0$), and dissolved it completely in 50 cm^3 of water. The drop in temperature was 3.8 ^oC.

What is the enthalpy change of this reaction in $kJ\ mol^{-1}$?

(The specific heat capacity of solution is 4.18 $J\ cm^{-3}\ ^oC^{-1}$)

A $\left(\dfrac{4.2 \times 4.18 \times 3.8}{1000} \right)$

B $\left(\dfrac{50 \times 4.18 \times 3.8 \times 84.0}{4.2 \times 1000} \right)$

C $\left(\dfrac{50 \times 4.18 \times 3.8}{1000} \right)$

D $\left(\dfrac{4.2 \times 4.18 \times 3.8 \times 84.0}{4.2 \times 1000} \right)$

9 The kinetics of the reaction between thiosulfate ions and acid is studied by varying the concentrations and measuring the time taken for the 'cross' to be totally obscured by the sulfur produced. The results are recorded in the table below.

$$S_2O_3^{2-}(aq) + 2H^+(aq) \rightarrow H_2O(l) + SO_2(g) + S(s)$$
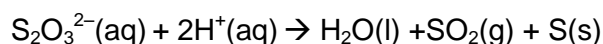
Experiment	Vol of $S_2O_3^{2-}$ /cm^3	Vol of H^+/cm^3	Vol of H_2O/cm^3	Time taken/min
1	30	30	10	11.0
2	30	40	0	10.0
3	45	20	5	6.5

What is the order of reaction with respect to each of the reactant?

	Order with respect to $S_2O_3^{2-}$	Order with respect to H^+
A	0	1
B	1	0
C	1	1
D	2	0

10 The reaction of hydrogen peroxide with iodide ions in acidic medium is as shown:

$$H_2O_2(aq) + 2H^+(aq) + 2I^-(aq) \rightarrow 2H_2O(l) + I_2(aq)$$
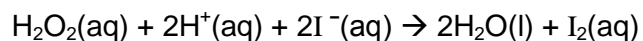
It is found that the order of reaction with respect to hydrogen peroxide and iodide ions is 1 respectively.

The product of concentrations of hydrogen peroxide and iodide ions is plotted against time, t for the following reaction. Which of the following graph is obtained?


A $[H_2O_2] [I^-]$ vs t

B $[H_2O_2] [I^-]$ vs t

C $[H_2O_2] [I^-]$ vs t

D $[H_2O_2] [I^-]$ vs t
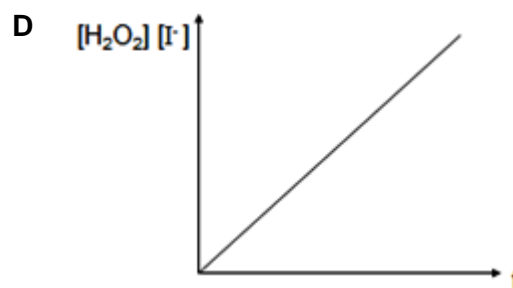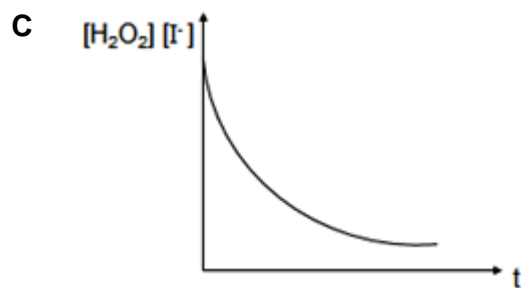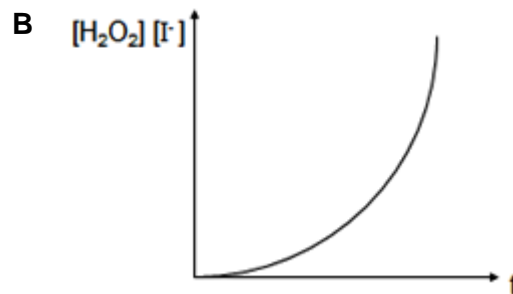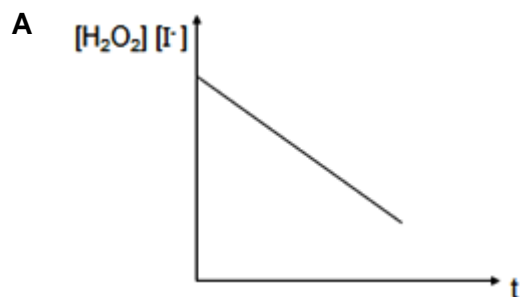
11 **W** and **Y** are mixed in a vessel to form **X** as shown. At time t min, the equilibrium mixture is subjected to a change.

$$2W(g) + Y(g) \rightleftharpoons 2X(g) \qquad \Delta H < 0$$
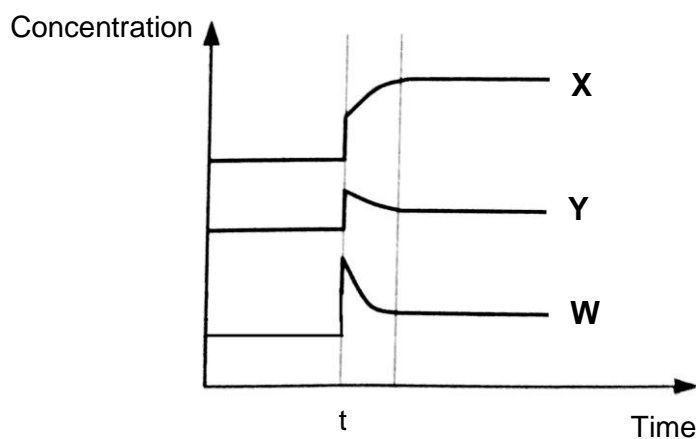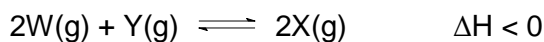
Which of the following changes made would result in the graph above?

A Decrease the temperature.

B Decrease the volume of container.

C Add 1 mol of neon gas.

D Add 1 mol of X(g).

12 Water dissociates into H^+ and OH^- as shown.

$$H_2O \rightleftharpoons H^+ + OH^-$$
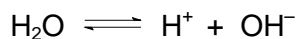
At 25 °C, the equilibrium $[H^+]$ is 10^{-7} mol dm^{-3}; density of H_2O = 1 kg dm^{-3}.

What is the order of increasing numerical value of pH, pK_a and pK_w for this equilibrium at this temperature?

A pH, pK_a, pK_w

B pH, pK_w, pK_a

C pK_a, pK_w, pH

D pK_w, pK_a, pH

13   An enzyme required in laboratory process operates at maximum efficiency when placed in an aqueous solution buffered at pH 5.6.

Which combination of substances when dissolved in water would give the appropriate buffer solution?

A   0.5 mol of HCl and 1 mol of CH_3COOH

B   0.5 mol of HCl and 1 mol of CH_3COONa

C   1 mol of CH_3COOH and 1 mol of $NaOH$

D   1 mol of CH_3COONH_4

14   Which factor helps to explain why the first ionisation energies of the Group II elements decrease from beryllium to magnesium to calcium to strontium?

A   The nuclear charge of the elements increases.

B   The shielding effect of the inner shells increases.

C   The outer electron is in 's' subshell.

D   The repulsion between spin–paired electrons increases.

15   **P**, **Q** and **R** are consecutive elements in Period 3 of the Periodic Table. **Q** has the highest first ionisation energy and the lowest melting point among the three elements.

Which of the following could be **P**, **Q** and **R**?

A   aluminium, silicon, phosphorus

B   sodium, magnesium, aluminium

C   magnesium, aluminium, silicon

D   silicon, phosphorus, sulfur

16   Element **S** is found in Period 3 of the Periodic Table.

The oxide and chloride of element **S** are separately mixed with water. The two resulting solutions have the same effect on universal indicator.

What is the identity of element **S**?

A   Sodium

B   Magnesium

C   Aluminum

**D**   Phosphorous

     [Turn over

17 Cholesterol is the most common steroid alcohol. It has a molecular formula of $C_{27}H_{46}O$ and has the structure shown.
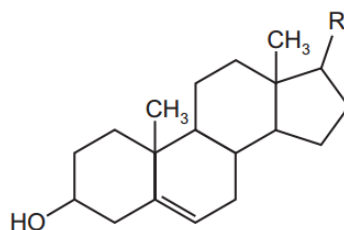
How many carbon atoms are in the hydrocarbon group R?

A 7

B 8

C 9

D 10

18 Which property of benzene may be directly attributed to the stability associated with its delocalised electrons?

A It has a low boiling point.

B It tends to undergo substitution rather than addition reactions.

C It does not conduct electricity.

D It does not react with sodium.

19 Jasmone is an active ingredient of jasmine. It is extracted from jasmine flowers for perfume.
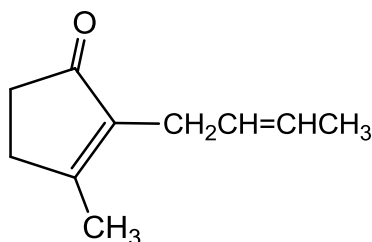
Jasmone

Which of the following statements is correct?

A It exists as a pair of *cis-trans* isomers.

B There are 4 sp^3 carbon atoms in Jasmone.

C Effervescence is observed when Jasmone is heated with acidified $KMnO_4$.

D A reddish brown precipitate is observed when hot alkaline Cu^{2+} complex solution was added to Jasmone.

20 The compound C_3H_7Br undergoes a sequence of reactions as follows:

$$C_3H_7Br \xrightarrow{OH^-(aq)} X \xrightarrow{Cr_2O_7^{2-}(aq)} Y \xrightarrow{\text{Tollens' reagent}/H^+} Z + \text{silver mirror}$$

What are the compounds **X**, **Y** and **Z**?

	X	Y	Z
A	$CH_3CH(OH)CH_3$	$CH_3CH_2CO_2H$	CH_3CH_2CHO
B	$CH_3CH_2CH_2OH$	CH_3CH_2CHO	CH_3CO_2H
C	$CH_3CH_2CH_2OH$	CH_3CH_2CHO	$CH_3CH_2CO_2H$
D	$CH_3CH(OH)CH_3$	CH_3COCH_3	CH_3CO_2H

21 Which compounds will not produce CHI_3 on warming with alkaline $I_2(aq)$?

A $CH_3CO_2CHICOCH_3$

B $C_6H_5COCH_2I$

C $CH_3CO_2CI_3$

D $I_2CHCH(OH)CH_3$

22 Which of the following is arranged in order of decreasing pK_a?

    A $ClCH_2CO_2H$, $BrCH_2CO_2H$, $BrCH_2CH_2CO_2H$, CH_3CH_2OH

    B CH_3CH_2OH, $BrCH_2CO_2H$, $BrCH_2CH_2CO_2H$, $ClCH_2CO_2H$

    C CH_3CH_2OH, $BrCH_2CH_2CO_2H$, $BrCH_2CO_2H$, $ClCH_2CO_2H$

    D $BrCH_2CO_2H$, $ClCH_2CO_2H$, $BrCH_2CH_2CO_2H$, CH_3CH_2OH

23 Oranges contain citric acid with the following structural formula.
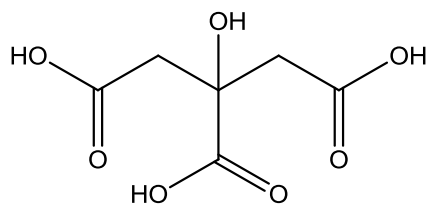
Which of the following will exactly react with one mole of citric acid?

    A   3 mol of Na_2CO_3

    B   3 mol of PCl_5

    C   4 mol of Na

    D   4 mol of NaOH

24 In which class of compound, in its general formula, is the ratio of hydrogen atoms to carbon atoms the highest?

    A   alcohols

    B   aldehydes

    C   carboxylic acids

    D   halogenoalkanes

25 A food chemist wants to create the odour of green apples for a product. An ester with this odour has the formula $C_2H_5CO_2CH(CH_3)_2$.

In which of the following will the substances react together to produce this ester?

A C_2H_5OH and $(CH_3)_2CHCOOH$

B CH_3COOH and $CH_3CH(OH)CH_2CH_3$

C C_2H_5COOH and $C_2H_5CH_2OH$

D C_2H_5COOH and $(CH_3)_2CHOH$

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

   In which pairs do both species have the same number of unpaired p electrons?

   1   O and Cl^+

   2   As and Ar^+

   3 F^+ and Ga^+

27 The enthalpy change of formation of carbon monoxide and carbon dioxide are given below.

   ΔH_f CO $= -110$ kJ mol^{-1}

   ΔH_f CO$_2$ $= -393$ kJ mol^{-1}

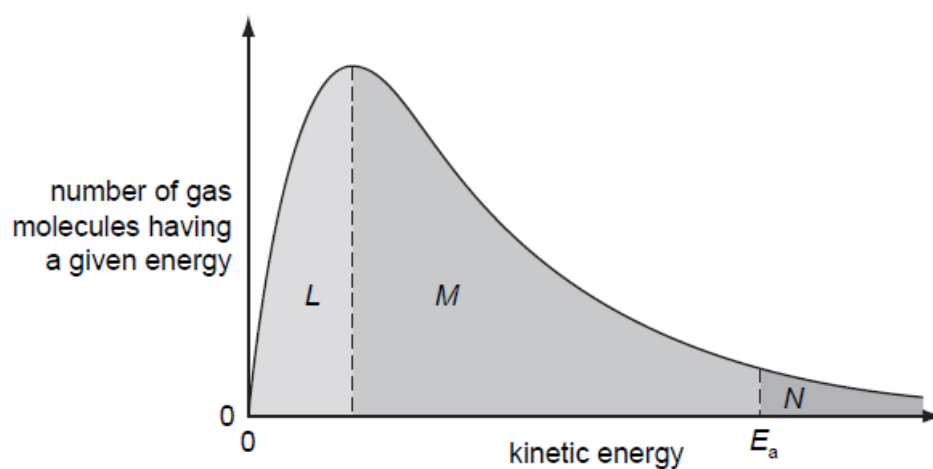   Which of these statement(s) is/are correct?

   1   Carbon monoxide has an exothermic enthalpy change of combustion.

   2   Carbon dioxide is energetically more stable than carbon monoxide.

   3   The enthalpy change of combustion of carbon is -393 kJ mol^{-1}.

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.

28   The Boltzmann distribution shows the number of molecules having a particular kinetic energy at constant temperature.

Which of the following statement(s) is/are true?

1   The maximum of the curve shifts to the right when the temperature is raised.

2   The E_a decreases when the temperature increases.

3   Lowering the temperature will decrease the total areas labelled L, M and N.

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

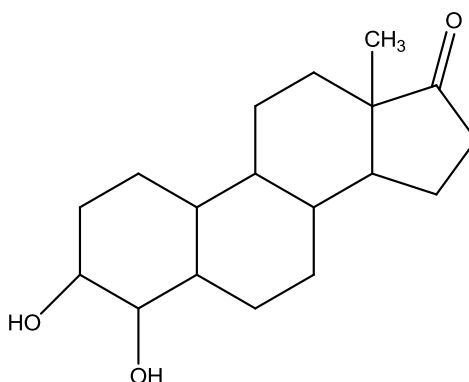| A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

29 Which of the following tests can be used to distinguish between the two organic compounds below?

CH_2CHO

$CH_3CH=CHCH_2OH$
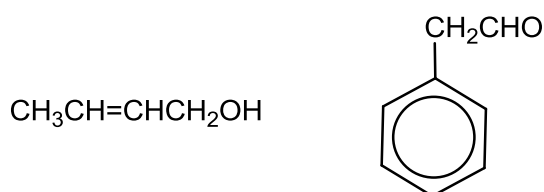
1 Na metal

2 Aqueous bromine, in the dark

3 2,4-Dinitrophenylhydrazine

30

The steroid shown is an intermediate compound obtained during the synthesis of Formestane which is used in the treatment of breast cancer.

Which statement about this compound is correct?

1 It reacts with hydrogen cyanide in an addition reaction.

2 It can be oxidised by warm acidified potassium dichromate(VI) to a carboxylic acid.

3 It will react with Fehling's solution.

END OF PAPER