NATIONAL JUNIOR COLLEGE
SH2 PRELIMINARY EXAMINATION

Higher 1

CANDIDATE NAME			
SUBJECT CLASS		REGISTRATION NUMBER	

CHEMISTRY

8872/01

Paper 1 Multiple Choice

Thursday 14 Sept 2017
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 fluid.
Write your name, subject class and registration number on the Answer Sheet in the spaces provided unless this has been done for you.

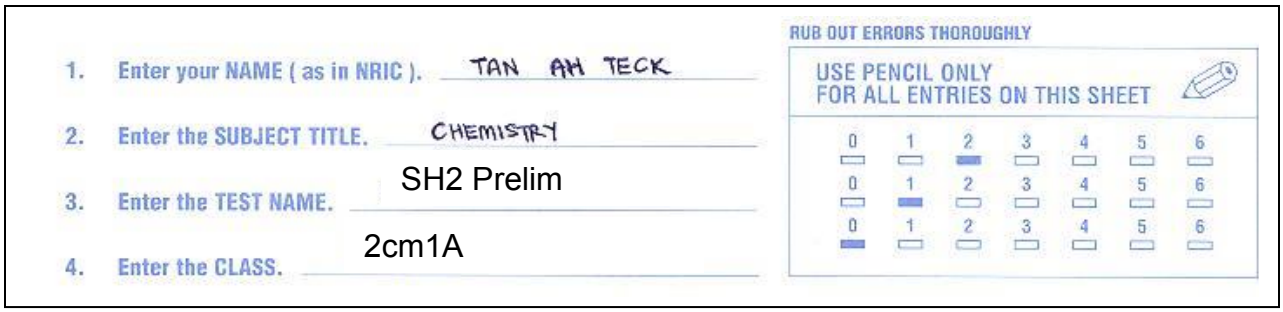
There are **30** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

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.

Instructions on how to fill in the Optical Mark Sheet



Example:

Shade the index number in a 5 digit format on the optical mark sheet: 2nd digit and the last 4 digits of the Registration Number.

Student	Examples of Registration No.	Shade:
	1605648	65648

Section A

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

1 How many molecules are present in 5 cm^3 of methane under room conditions?

A $\dfrac{5 \times 24000}{6.02 \times 10^{23}}$

B $\dfrac{5 \times 6.02 \times 10^{23}}{24000}$

C $5 \times 6.02 \times 10^{23} \times 24000$

D $\dfrac{24000}{5 \times 6.02 \times 10^{23}}$

2 Ions of the two most common isotopes of iron are shown below:

$$^{54}_{26}Fe^{2+} \qquad ^{56}_{26}Fe^{2+}$$

Which statement is true?

A Both of these Fe^{2+} ions have the same number of electrons but different number of protons.

B The $^{54}_{26}Fe^{2+}$ ion will be deflected more than the $^{56}_{26}Fe^{2+}$ ion when passing through an electric field of same strength.

C The $^{56}_{26}Fe^{2+}$ ion have more protons than the $^{54}_{26}Fe^{2+}$ ion.

D The electron arrangement of both these Fe^{2+} ions is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4 4s^2$.

3 10 cm^3 of a hydrocarbon C_xH_y was exploded in 100 cm^3 of oxygen gas and cooled to room temperature. There was a contraction of 30 cm^3. When the resulting gas was passed through a solution of sodium hydroxide, there was a further contraction of 40 cm^3. All volumes measured are under room conditions.

What is the molecular formula of the hydrocarbon?

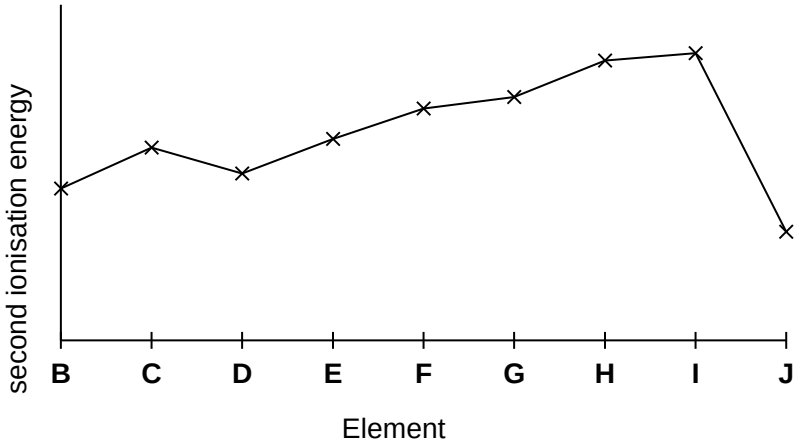
A C_4H_8

B C_4H_{10}

C C_3H_6

D C_3H_{10}

4 The following graph represents the second ionisation energy trend of 9 consecutive elements in Periods 3 and 4.



Which statement is correct?

A Element **C** is in Group 3.

B Element **F** has the lowest boiling point.

C The ionic radius of ion of **E** is greater than that of ion of **J**.

D The formula of the compound formed between elements **D** and **G** is $\mathbf{D_2G_3}$.

5 Two elements, **X** and **Y**, have the following properties.

- **X** and **Y** form ionic compounds Ca**X** and Ca**Y** respectively.
- Element **X** forms **X**F_6 molecule while **Y** is unable to do so.

Which options shows the correct electronic configuration of **X** and **Y**?

	X	**Y**
A	[Ne] $3s^2$ $3p^2$	[He] $2s^1$
B	[Ne] $3s^2$ $3p^4$	[He] $2s^1$
C	[Ne] $3s^2$ $3p^2$	[He] $2s^2$ $2p^4$
D	[Ne] $3s^2$ $3p^4$	[He] $2s^2$ $2p^4$

6 For which system does the equilibrium constant, K_c, have units of $mol^{-2}dm^6$?

A $CH_3CH_2OH(l) + CH_3COOH(l) \rightleftharpoons CH_3COOCH_2CH_3(l) + H_2O(l)$

B $NH_3(aq) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

C $N_2(g) + 3H_2(g) \rightleftharpoons 2\ NH_3(g)$

D $2CrO_4^{2-}(aq) + 2H^+(aq) \rightleftharpoons Cr_2O_7^{2-}(aq) + H_2O(l)$

7 Which compound is the most volatile?

A $CH_3CH_2CH_2CH_2NH_2$

B $CH_3CH(CH_3)CH_2NH_2$

C $CH_3CH(NH_2)CH_2CH_3$

D $CH_3C(CH_3)_2NH_2$

8 Which reaction has a positive ΔH value?

A $Na(s) \rightarrow Na(g)$

B $OH^-(aq) + H^+(aq) \rightarrow H_2O(l)$

C $2\ Cl(g) \rightarrow Cl_2(g)$

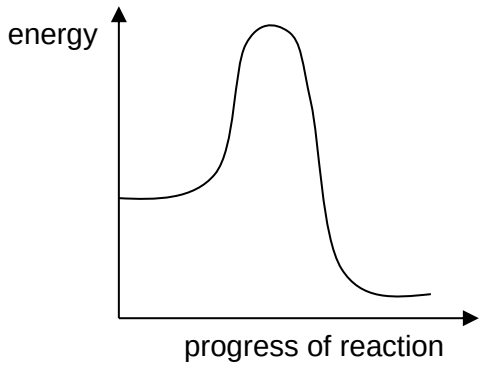
D $CH_4(g) + O_2(g) \rightarrow CO_2(g) + H_2O(l)$

9 A series of reactions between 2**X** and **Y** to give **Z** is shown below, where the overall enthalpy change of reaction is negative.

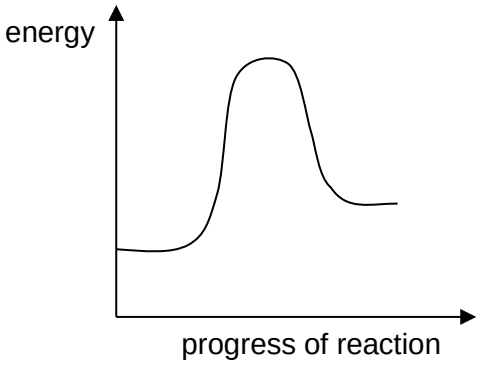
Step 1: **X** + **Y** → **U**
Step 2: **X** + **U** → **Z**

Which diagram represents the energy profile diagram of the reaction?

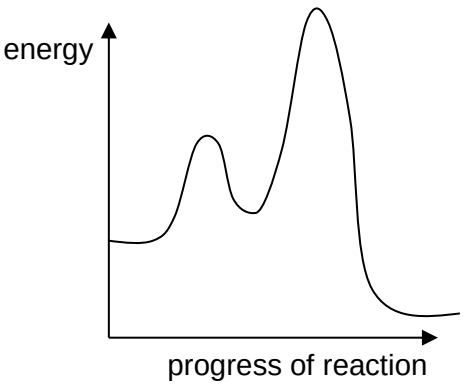
A



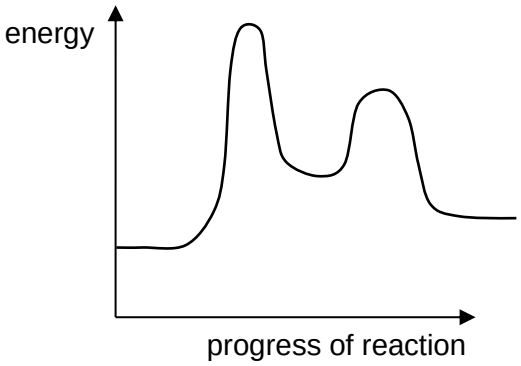
C



B



D



10 The bond dissociation energy of H–C*l* is +432 kJ mol^{-1}.

Which of the following processes have an enthalpy change of −432 kJ mol^{-1}?

A HC*l* (s) → H(g) + C*l*(g)

B HC*l* (g) → H(g) + C*l*(g)

C H(g) + C*l*(g) → HC*l* (s)

D H(g) + C*l*(g) → HC*l* (g)

11 The enthalpy change of neutralisation between 1 mole of HC*l* and 1 mole of NaOH is given below.

$$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l) \qquad \Delta H = -57.3 \text{ kJ mol}^{-1}$$

The enthalpy change of neutralisation between 1 mole of CH_3COOH and 1 mole of NaOH is less than −57 kJ mol^{-1}.

$$NaOH(aq) + CH_3CO_2H\ (aq) \rightarrow CH_3CO_2^-Na^+(aq) + H_2O(l) \qquad \Delta H = -54.7 \text{ kJ mol}^{-1}$$

Which statement best explains the difference between these two values?

A Heat is lost to the surroundings.

B The reaction between NaOH and CH_3CO_2H is incomplete.

C Dissociation of CH_3CO_2H is endothermic.

D CH_3CO_2H can form hydrogen bonds with water but not HC*l*.

12 Which indicator is suitable for use in a titration of 0.1 mol dm^{-3} H_2SO_4 with 0.1 mol dm^{-3} of NH_3?

A Methyl Orange (pH range 3.3 – 4.4)

B Bromothymol blue (pH range 6.0 – 7.6)

C Phenolphthalein (pH range 8.3 – 10.0)

D None of the above

13 Which mixtures, when mixed at equal volumes, would result in a buffer solution?

A 0.10 mol dm^{-3} CH_3CO_2Na and 0.05 mol dm^{-3} HC*l*

B 0.05 mol dm^{-3} CH_3CO_2H and 0.10 mol dm^{-3} NaOH

C 0.05 mol dm^{-3} CH_3CO_2H and 0.05 mol dm^{-3} NaC*l*

D 0.10 mol dm^{-3} HC*l* and 0.10 mol dm^{-3} NaOH

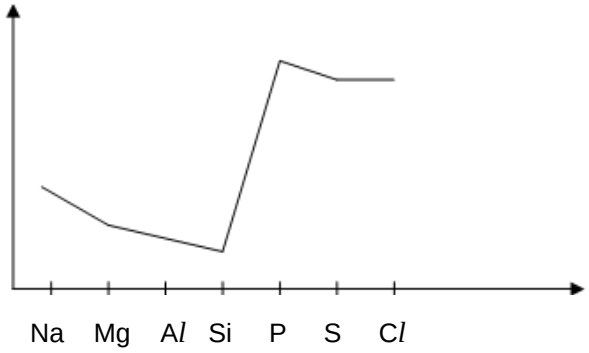
14 A theoretical reaction involves **X** + **Y** → **Z**

The rate equation is rate = $k[\mathbf{X}]^p[\mathbf{Y}]^q$ and the units of the rate constant, *k*, are $(\text{mol dm}^{-3})^r \text{ min}^{-1}$.

Which set of the values of *p*, *q* and *r* fits the above information?

	P	*q*	*r*
A	2	0	−2
B	2	1	2
C	1	0	0
D	1	1	1

15 What property of Period 3 is shown by the graph below?



A Melting point

B Ionic radius

C Electrical conductivity

D pH of chlorides

16 Xenon is the final product formed by a series of changes in the radioactive decay of iodine 131. This radioactive decay is a *first-order reaction* with a half-life of 8 days.

What is the time period required for an iodine sample which was originally xenon free, to have a molar proportion of Iodine to Xenon in a 1:7?

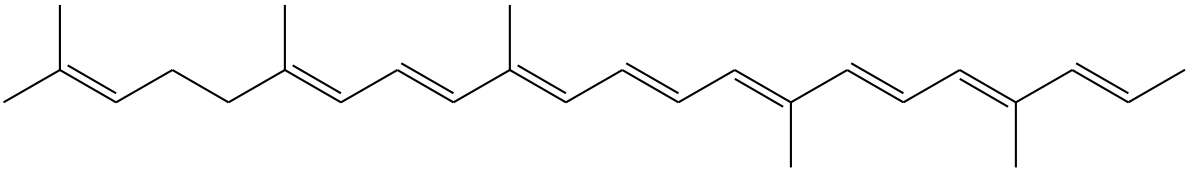
A 8 days

B 16 days

C 24 days

D 32 days

17 Determine the number of geometric isomers in the compound below:



A 2^6

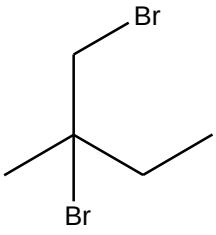
B 2^7

C 2^8

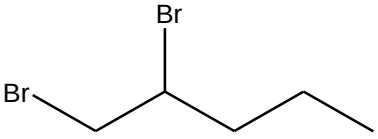
D 2^9

18 Which compound **could not** be formed by the action of bromine on an alkene of molecular formula C_5H_{10}?

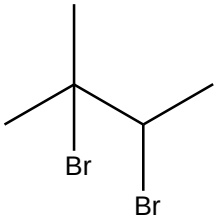
A



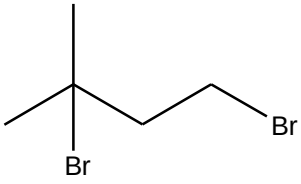
B



C



D



19 What is the structural formula of the alkene that undergoes mild oxidation to give a diol and further oxidation to give a diketone?

A $(C_2H_5)_2C=C(CH_3)_2$

B $CH_3CH=CHCH_3$

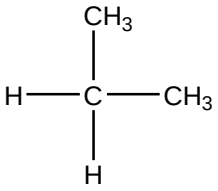
C $C_2H_5CH=C(CH_3)_2$

D $(CH_3)_2C=CHC_2H_5$

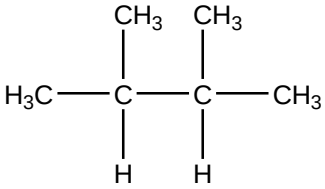
20 An alkane **Z** is reacted with chlorine gas in the presence of ultraviolet light to form two monochlorinated alkanes in an approximate molar ratio of 3 : 1.

Which of the following is a possible structure for **Z**?

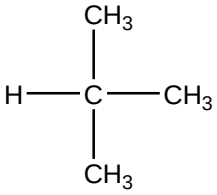
A



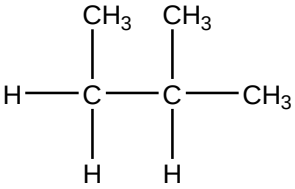
B



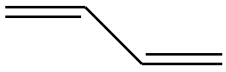
C



D

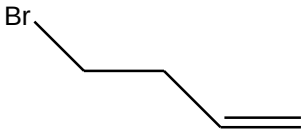


21 What is the major product formed when 1 mole of buta-1,3-diene reacts with 1 mole HBr(g)?

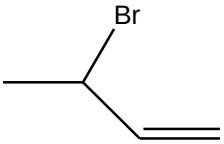


buta-1,3-diene

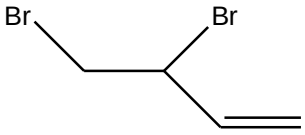
A



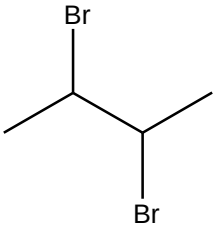
B



C



D



22 How many structural isomers of alcohol with the molecular formula, $C_4H_{10}O$, have?

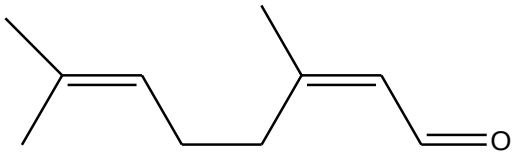
A 1

B 2

C 3

D 4

23 Which of the following is not a final product of the vigorous oxidation of citral?



citral

A CO_2

B CH_3COCH_3

C $CH_3COCH_2CH_2CO_2H$

D $(CO_2H)_2$

24 A company wants to create a perfume with an ester that 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 $(CH_3)_2CHOH$

D C_2H_5COOH and $C_2H_5CH_2OH$

25 A sample of propanal is treated with HCN in the presence of NaCN. The organic product is then refluxed with $LiAlH_4$ in dry ether.

What will be the final product?

A $CH_3CH_2CH(OH)CH_2NH_2$

B $CH_3CH_2CH(OH)CO_2H$

C $CH_3CH_2CH(OH)CONH_2$

D $CH_3CH_2COCO_2H$

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 For which pairs does species **I** have a smaller bond angle than species **II**?

	Species **I**	Species **II**
1	H_2S	SO_2
2	CO_2	CH_4
3	NH_4^+	NH_3

27 In microwave ovens, the wave energy is absorbed by polar molecules.

Which molecules would absorb microwave energy?

1 CH_3Cl

2 CH_3CO_2H

3 SO_3

28 Which reactions **can** represent standard enthalpy changes at 298 K?

1 $2C(s) + 3H_2(g) \rightarrow C_2H_6(g)$

2 $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

3 $Ca(s) + C(s) + \frac{3}{2} O_2(g) \rightarrow CaCO_3(s)$

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.

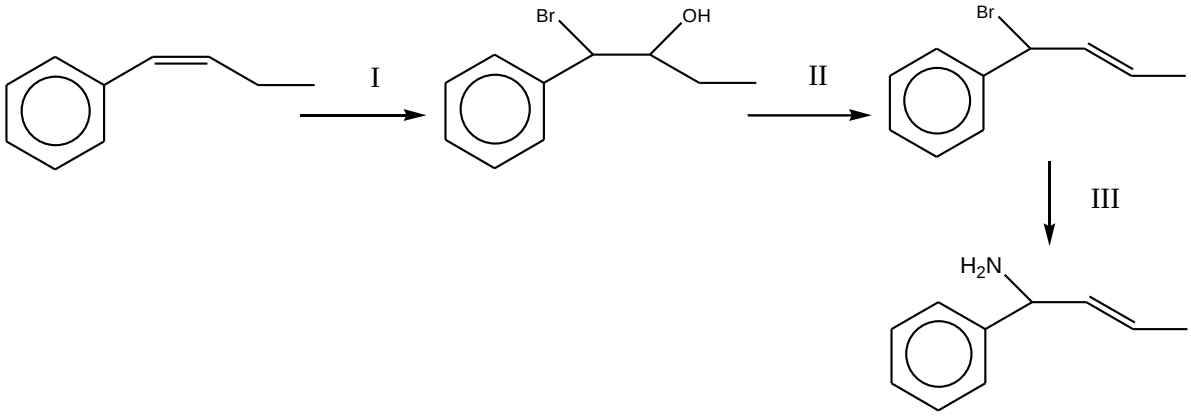
29 Which compounds yields only a single product upon heating with concentrated H_2SO_4?

1 $CH_3CH_2CH_2CH_2OH$

2 $CH_3C(OH)(CH_3)_2$

3 $CH_3CH_2CH(OH)CH_3$

30 Which types of reactions are involved in the reaction scheme below?



1 Addition

2 Substitution

3 Elimination