HWA CHONG INSTITUTION
C1 Promotional Examination
Higher 2

NAME		**CT GROUP**	**18S**

CHEMISTRY **9729/01**

Paper 1 Multiple Choice **2 October 2018**

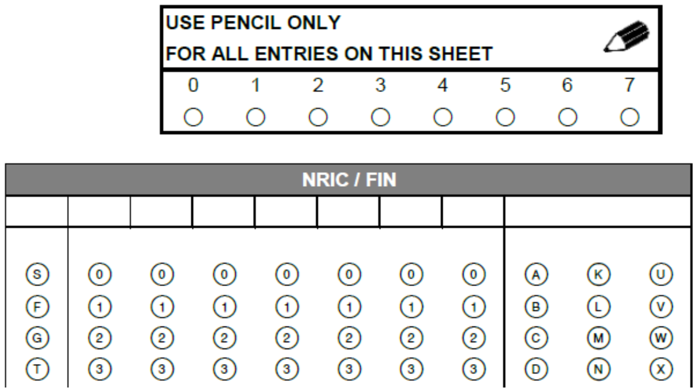
40 min

Additional Materials: Multiple Choice Answer Sheet
Data Booklet.

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Complete the information on the optical mark sheet (OMS) as shown below.

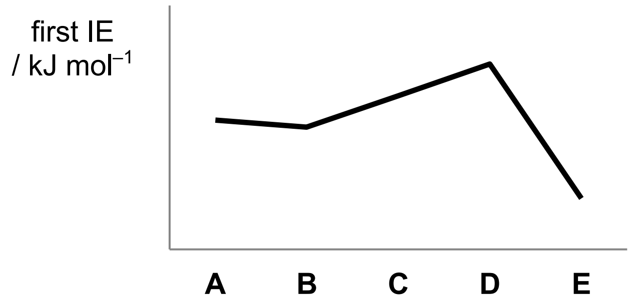
1. Enter your **NAME** (as in NRIC).
2. Enter the **PAPER NUMBER.**
3. Enter your **CT GROUP.**
4. Enter your **NRIC NUMBER** or **FIN Number**
5. Now **SHADE** the corresponding circles in the grid for **EACH DIGIT** or **LETTER**



There are **twenty** 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 OMS.

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.

1 The graph shows the first ionisation energies of five consecutive elements in the Periodic Table.



Which group does **D** belong to?

A 2 **B** 14 **C** 15 **D** 18

2 Semiconductors are widely used in electronic devices. An element can be a semiconductor if it meets the following criteria:

- One of its electronic levels is fully occupied (such as an *s* subshell)
- The level immediately above this level is of only slightly higher energy, and is empty or partially filled (such as a *p* subshell)

On this basis, which elements are expected to be semiconductors?

1 $_{31}Ga$

2 $_{34}Se$

3 $_{55}Cs$

A 1 only

B 1 and 2 only

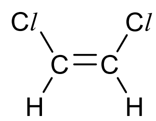
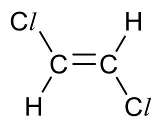
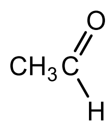
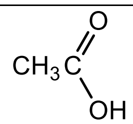
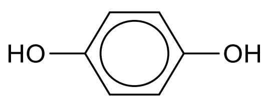
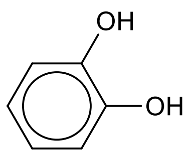
C 2 and 3 only

D 1, 2 and 3

3 In which pair does species **I** have a smaller bond angle than species **II**?

	I	**II**
A	NO_3^-	NO_2^-
B	ClF_4^-	SF_6
C	XeF_4	BrF_5
D	BrO_3^-	ClO_3^-

4 Which pair of compounds is arranged in the correct order of relative boiling points?

	Lower boiling point	**Higher boiling point**
A		
B	CH_3CH_2OH	
C	CH_3CH_2OH	
D		

5 Carbon forms double bonds with each of the three elements oxygen, sulfur and selenium. In each case, the double bond is polar.

In the linear molecules, carbon dioxide, carbonyl sulfide (COS) and carbonyl selenide (COSe), the polarities of these double bonds do not necessarily cancel.

	Overall polarity of molecule
O=C=O	0
O=C=S	0.71
O=C=Se	0.73

Which factors could account for these observations?

1 The C=S bond is more polar than the C=Se bond.

2 The C=O bond is more polar than the C=S bond.

3 The C=Se bond is more polar than the C=O bond.

A 1 only

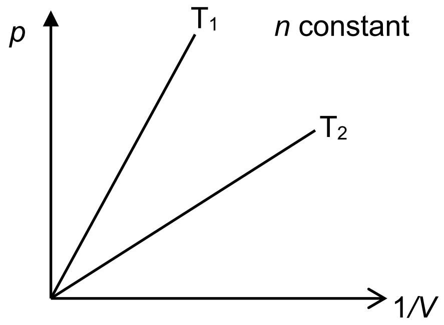
B 1 and 2 only

C 1 and 3 only

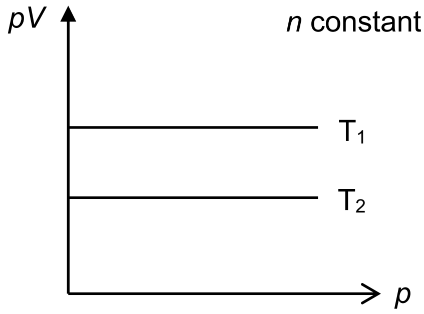
D 2 and 3 only

6 Each of the following graphs represents plots for an ideal gas at two different temperatures. Which graph shows the correct relationship where temperature T_1 is lower than T_2?

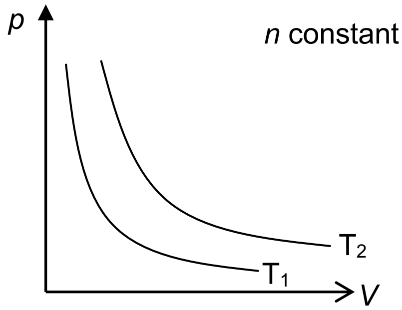
A



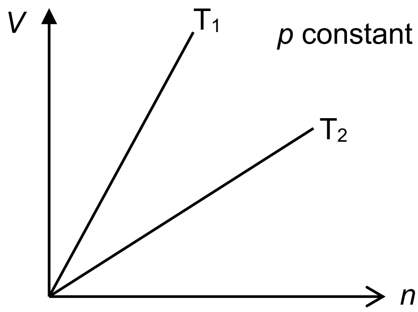
B



C



D



7 The amount of urea present in urine can be determined by measuring the volume of gases liberated when urea is treated with excess nitrous acid.

$$NH_2CONH_2 + 2HNO_2 \rightarrow CO_2 + 2N_2 + 3H_2O$$

0.150 g of urea was treated with excess nitrous acid, and the gas produced was passed through aqueous NaOH. What is the volume of the gas at room temperature and pressure after passing through aqueous NaOH?

A 60 cm^3 **B** 120 cm^3 **C** 180 cm^3 **D** 300 cm^3

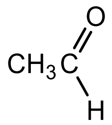
8 Isotopic abundances vary greatly depending on the sample that is analyzed.

The molar mass of isotopically pure ^{106}Pd is precisely 105.903 g mol^{-1}. However, in one sample of palladium, the molar mass of the sample was found to be 106.003 g mol^{-1}.

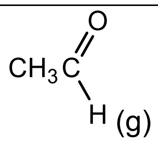
Which isotope, present in this sample, caused this discrepancy?

A ^{108}Pd **B** ^{105}Pd **C** ^{104}Pd **D** ^{102}Pd

9 Ethanol can be formed from ethanal by reduction using hydrogen gas and nickel.

 (g) + $H_2(g)$ → $CH_3CH_2OH(g)$

The enthalpy changes of combustion, $\Delta H^{\ominus}_c$, of the reactants and product of this reaction are shown below.

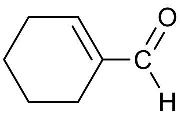
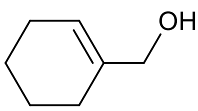
		$H_2(g)$	$CH_3CH_2OH(g)$
$\Delta H^{\ominus}_c$ / kJ mol^{-1}	–1167	–286	–1367

Which of the following statements are correct?

1 This reaction is spontaneous at high temperatures.

2 The standard enthalpy change of reaction is –86 kJ mol^{-1}.

3 Nickel acts as a heterogeneous catalyst for this reaction.

4  will be reduced to form  under the same conditions.

A 2 and 3 only

B 1, 2 and 3 only

C 2, 3 and 4 only

D All are correct

10 Which of the following reactions has a negative ΔS?

A Heating solid calcium carbonate.

B Sublimation of solid carbon dioxide.

C Rusting of an iron bar to form iron(III) oxide.

D Reaction between aqueous sodium hydroxide and aqueous ammonium chloride.

11 The reaction of acidified aqueous potassium iodide with aqueous hydrogen peroxide:

$$2I^-(aq) + H_2O_2(aq) + 2H^+(aq) \rightarrow I_2(aq) + 2H_2O(l)$$

is thought to involve the following steps:

step 1: $H_2O_2 + I^- \rightarrow H_2O + OI^-$ (slow)
step 2: $OI^- + H^+ \rightarrow HOI$
step 3: $HOI + H^+ + I^- \rightarrow I_2 + H_2O$

Which of the following conclusions can be drawn from this information?

1 The acid is acting as a catalyst.

2 OI^- and HOI are intermediates.

3 Step 2 has a lower activation energy than step 1.

4 The reaction is overall second order.

A 1 and 2 only

B 2 and 3 only

C 1 and 3 only

D 2, 3 and 4 only

12 The following data were obtained from studies of the reaction between NO and O_2 in a vessel at constant temperature.

Experiment	**I**	**II**	**III**	**IV**
Total initial pressure / atm	1.00	1.60	2.00	x
Initial pressure of NO / atm	0.40	0.40	0.80	0.20
Initial rate of reaction / atm s^{-1}	1.08	2.16	8.64	1.08

Which of the following statements is correct regarding the above system?

A The reaction is first order with respect to NO.

B The rate equation is rate = kP_{NO}^{2}.

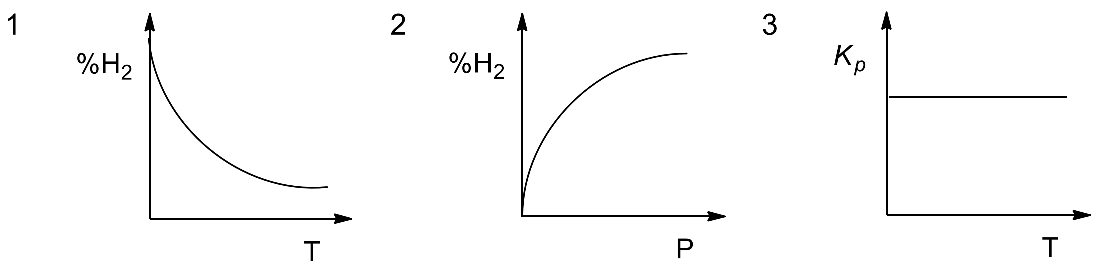
C The rate constant k has units of $atm^{-2}\ s^{-1}$.

D The value of x in the table above is 2.40.

13 The water-gas shift reaction is an industrially important source of hydrogen gas because of the low cost of the reactants. The reactants and products of this reaction exist in an equilibrium that is shown below.

$$CO(g) + H_2O(g) = CO_2(g) + H_2(g) \qquad \Delta H = -41\ kJ\ mol^{-1}$$

Which of the following graphs based on the water-gas shift reaction, are correct?



A 1 only

B 1 and 2 only

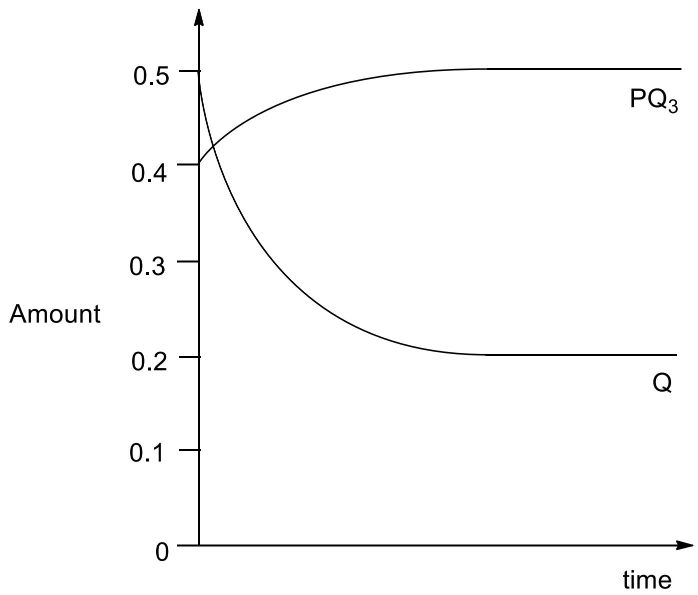
C 2 and 3 only

D 1, 2 and 3

14 Two gases, P and Q, react as follows.

$$P\ (g) + 3Q\ (g) \rightleftharpoons PQ_3\ (g)$$

A system containing, P, Q and PQ_3 is allowed to reach equilibrium in a 5 dm^3 vessel at a temperature of 1000 K. The diagram shows the change in the amount of PQ_3 and Q with time.



Given that the initial amount of P was 0.2 mol, what is the value of the equilibrium constant K_c for this reaction?

A $\dfrac{0.5}{0.1 \times (0.2)^3}$

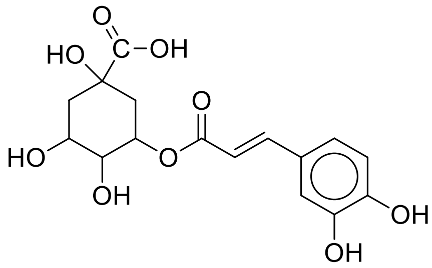
B $\dfrac{0.5 \times 5^3}{0.1 \times (0.2)^3}$

C $\dfrac{0.5}{0.2 \times (0.2)^3}$

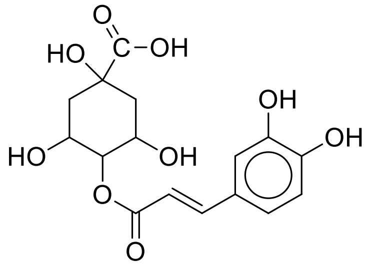
D $\dfrac{0.5 \times 5^3}{0.2 \times (0.2)^3}$

The structures of chlorogenic acid and cryptochlorogenic acid are relevant for Q15 and Q16.

15 Chlorogenic acid occurs naturally in coffee and an edible species of bamboo. Cryptochlorogenic acid is an isomer of chlorogenic acid, but is far less common in everyday food.



Chlorogenic acid



Cryptochlorogenic acid

Which functional group is **absent** in both chlorogenic acid and cryptochlorogenic acid?

A alkene

B alcohol

C carboxylic acid

D ketone

16 Which of the following statements about chlorogenic acid and cryptochlorogenic acid is **incorrect**?

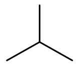
A Chlorogenic acid has 32 stereoisomers.

B Cryptochlorogenic acid contains four sp^2 hybridized carbon atoms.

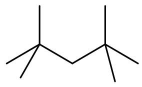
C Chlorogenic acid and cryptochlorogenic acid are constitutional isomers.

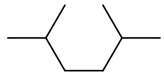
D Chlorogenic acid and cryptochlorogenic acid exhibit *cis-trans* isomerism.

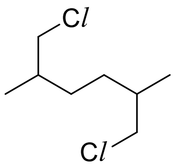
17 Which of the following is **not** a possible product of the reaction between 2-methylpropane and excess Cl_2 (g) in the presence of *uv* light?

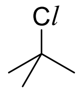


2-methylpropane

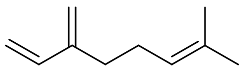
A 

B 

C 

D 

18 Myrcene is an aroma molecule that can be isolated from plants, and contributes to the distinctive scent of lilies.



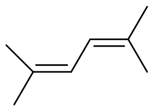
myrcene

When myrcene is completely reacted with HBr, the product mixture contains different compounds, all with the same molecular formula.

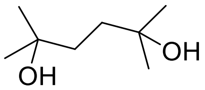
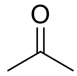
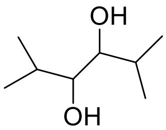
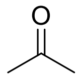
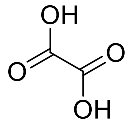
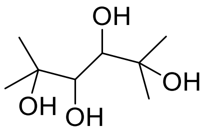
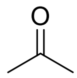
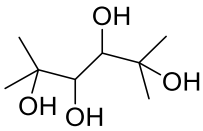
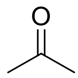
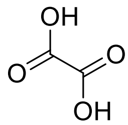
Which row identifies the molecular formula and the number of these products which are tertiary bromoalkanes (ignoring any stereoisomers)?

	molecular formula	number of products which are tertiary bromoalkanes
A	$C_{10}H_{16}Br_3$	3
B	$C_{10}H_{16}Br_3$	6
C	$C_{10}H_{19}Br_3$	3
D	$C_{10}H_{19}Br_3$	6

19 Under different conditions, compound **X** reacts with excess $KMnO_4$(aq) to give different products. Which would be the final organic products obtained under each condition?



X

	cold $KMnO_4$(aq), NaOH(aq)	**hot $KMnO_4$(aq), H_2SO_4(aq)**
A		
B		 
C		
D		 

20 Which synthesis sequence, using benzene as the starting material, would give the highest yield of 2-chloro-4-nitromethylbenzene?

A chlorination → nitration → alkylation

B nitration → chlorination → alkylation

C alkylation → chlorination → nitration

D alkylation → nitration → chlorination

– END OF PAPER –