HWA CHONG INSTITUTION
C1 Promotional Examination
Higher 2

CANDIDATE NAME		**CT GROUP**	**21S**

CHEMISTRY

9729/01

Paper 1 Multiple Choice

30 September 2021

Additional Materials: Multiple Choice Answer Sheet

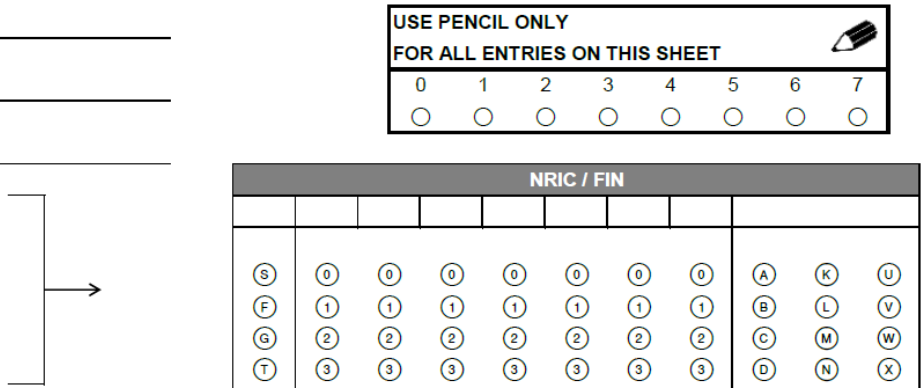
Data Booklet

40 min

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Complete the information on the Multiple Choice Answer Sheet 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 separate Answer Sheet.

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 Which particle does **not** contain either an unpaired s electron or an unpaired p electron?

1 Cr

2 Ge

3 S^{2-}

4 Sc

A 4 only **B** 1 and 2 only **C** 3 and 4 only **D** 1, 3 and 4 only

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

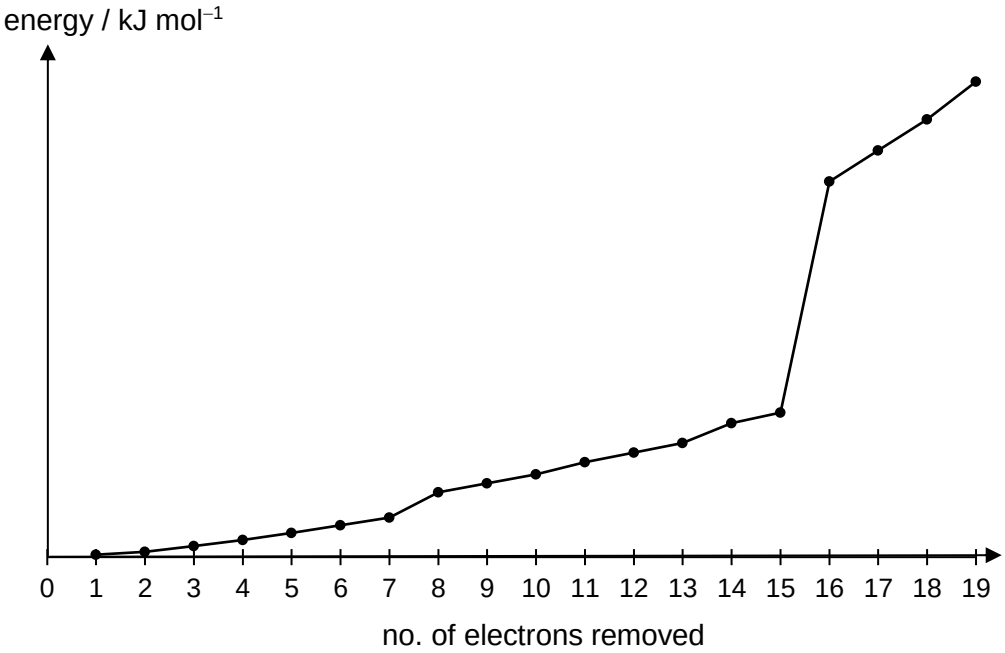
A scientist attempts to produce ^{14}C using a neutron and an isotope X of an element as shown in the equation below.

$$\text{one neutron} + X \rightarrow {}^{14}C + {}^{3}H$$

Which row in the table correctly states the number of neutrons in X and the identity of X?

	number of neutrons in X	identity of X
A	3	Li
B	7	Li
C	9	N
D	14	N

3 The graph shows the successive ionisation energies for the removal of the first 19 electrons from an element Y.



Which statement about Y may be correct?

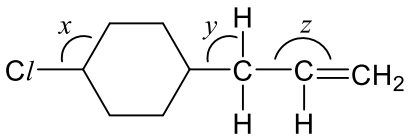
A Y is cobalt.

B Y is manganese.

C Y belongs to Group 14.

D Y belongs to Group 17.

4 A compound has the structure shown.



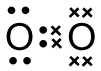
What are the values of the bond angles *x*, *y* and *z*?

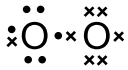
	x	*y*	*z*
A	109.5°	90°	180°
B	109.5°	109.5°	120°
C	120°	90°	180°
D	120°	109.5°	120°

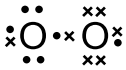
5 When barium metal burns in oxygen, the ionic compound barium peroxide, BaO_2, is formed.

Which dot-and-cross diagram could represent the structure of the peroxide anion in BaO_2?

A 

B 

C 

D 

6 In which pairs of compounds does the **first** molecule have a net dipole but the **second** molecule have no net dipole?

1 SO_2 and CO_2

2 PF_3 and BF_3

3 BrF_5 and SiF_4

A 1, 2 and 3

B 1 and 2 only

C 2 and 3 only

D 1 only

7 Flask A contains 1 dm^3 of helium at a pressure of 2 kPa, flask B contains 2 dm^3 of argon at a pressure of 4 kPa and flask C contains 4 dm^3 of water vapour at a pressure of 2 kPa. The temperature is measured to be 110 °C.

If the flasks are connected and the temperature is now decreased to 40 °C, what is the final pressure?

A 0.5 kPa

B 0.9 kPa

C 1.2 kPa

D 2.1 kPa

8 In an experiment, H_2S reacted with BrO_3^- in a 5:2 ratio to form elemental sulfur and a bromine-containing product. The reaction was carried out under acidic conditions.

What is the oxidation state of Br in the bromine-containing product?

A 0 **B** –1 **C** +1 **D** +3

9 When a 10 cm^3 sample of hydrocarbon was completely burnt in 100 cm^3 of oxygen, the final gaseous mixture which contained carbon dioxide and unreacted oxygen was found to have a volume of 75 cm^3. This final volume of gas was treated with an excess of aqueous potassium hydroxide and a further reduction of 40 cm^3 was observed. All gas volumes were measured at the same temperature and pressure.

What is the formula of the hydrocarbon?

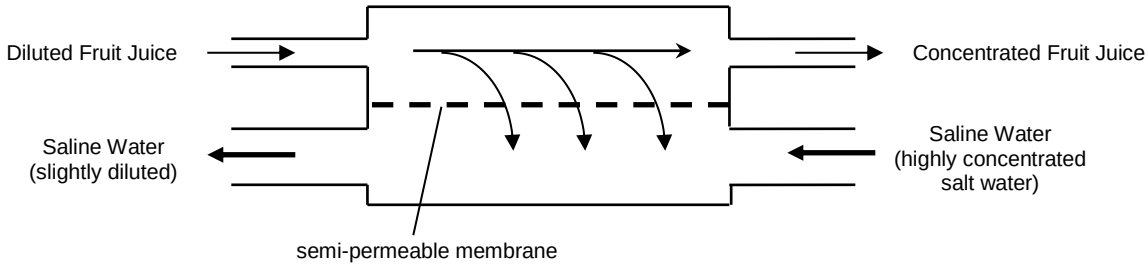
A C_2H_4

B C_2H_6

C C_4H_8

D C_4H_{10}

10 Forward osmosis is a process that uses a semi-permeable membrane to effect the separation of water via a natural osmotic pressure gradient, without applying an external pressure. A common application involves concentrating fruit juice as shown in the diagram below.



The semi-permeable membrane only allows small molecules such as water through, but retains all other molecules and ions.

The enthalpy change for the forward osmosis process is very small, and can be considered as being zero.

What are the correct signs of ΔS and ΔG for the forward osmosis process?

	ΔS	ΔG
A	–	–
B	+	–
C	–	+
D	+	+

11 In an experiment to measure the enthalpy change of solution of $MgCl_2$, a 2.00 g sample of the solid (M_r = 95.3) was dissolved completely in 100 cm^3 deionised water. The temperature rose by 7.5 °C.

Assuming that the specific heat capacity of water is 4.2 J g^{-1} K^{-1}, what is the enthalpy change of solution of $MgCl_2$ in J mol^{-1}?

A $-\dfrac{102 \times 4.2 \times (7.5 + 273)}{2.00 \div 95.3}$

B $-\dfrac{100 \times 4.2 \times (7.5 + 273)}{2.00 \div 95.3}$

C $-\dfrac{102 \times 4.2 \times 7.5}{2.00 \div 95.3}$

D $-\dfrac{100 \times 4.2 \times 7.5}{2.00 \div 95.3}$

12 Nitramide undergoes acid-catalysed decomposition according to the following equation.

$$\underset{\text{nitramide}}{H_2NNO_2(aq)} \xrightarrow{H^+(aq)} H_2O(l) + N_2O(g)$$

Which method is **not** suitable for studying the kinetics of this reaction?

A Measuring the change in [H^+(aq)] over time.

B Measuring the change in total mass of the reaction mixture over time.

C Connecting the reaction flask to a gas syringe and tracking the change in gas syringe reading over time.

D Connecting the reaction flask to a manometer and tracking the change in manometer reading over time.

13 The table below shows some experimental results obtained for the reaction between 1-bromopropane (RBr) and sodium hydroxide.

expt	volume of 0.010 mol dm^{-3} RBr / cm^3	volume of 0.50 mol dm^{-3} NaOH / cm^3	volume of deionised water / cm^3	total volume of reaction mixture / cm^3	rate of reaction / mol dm^{-3} min^{-1}
1	10.0	40.0	0.0	50.0	3.0×10^{-5}
2	5.0	10.0	10.0	25.0	1.5×10^{-5}
3	20.0	4.0	26.0	50.0	x

Given that the order of reaction with respect to RBr is one, and the half-life of RBr in experiment 1 is t min, which statement is correct?

A The order of reaction with respect to NaOH is zero.

B The new half-life of RBr in experiment 3 is 10t min.

C The value of the rate constant is 6.0×10^{-3}.

D The value of x is 6.0×10^{-5}.

14 Hydrogen reacts with gaseous bromine to form hydrogen bromide,

$$H_2(g) + Br_2(g) \rightarrow 2HBr(g)$$

and with gaseous iodine to form hydrogen iodide.

$$H_2(g) + I_2(g) \rightarrow 2HI(g)$$

For the first reaction, the rate equation is

$$\text{rate} = \frac{k_1[H_2][Br_2]^{1.5}}{[Br_2] + k_2[HBr]}$$

For the second reaction, the rate equation is

$$\text{rate} = k[H_2][I_2]$$

What can be deduced by the above information only?

1 Only the hydrogen/iodine reaction could be a single step reaction.

2 The mechanism of the hydrogen/bromine reaction involves free radicals.

3 The rate of formation of HI is twice the rate of consumption of I_2.

4 For the hydrogen/bromine reaction, the formation of HBr slows down the rate of the forward reaction.

A 2 only

B 1 and 3

C 1, 3 and 4

D All of the above

15 Methanol is manufactured industrially by the catalytic reaction shown.

$$CO(g) + 2H_2(g) \ll CH_3OH(g); \qquad \Delta H = -92 \text{ kJ mol}^{-1}$$

The operating conditions are:
250 °C; a pressure between 50 atm and 100 atm;
a copper-based catalyst

Which factor influences the choice of these conditions?

A The catalyst increases the equilibrium yield of methanol.

B At higher pressures, the equilibrium yield of methanol increases.

C At lower pressures, the rate of formation of methanol increases.

D At lower temperatures, the rate of formation of methanol increases.

16 In which molecules are all atoms on the same plane?

1 propene

2 benzene

3 ethyne

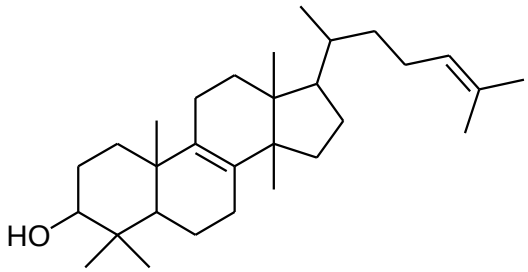
A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D All of the above

17 The compound *Lanosterol* is a tetracyclic triterpenoid from which all steroids are derived.

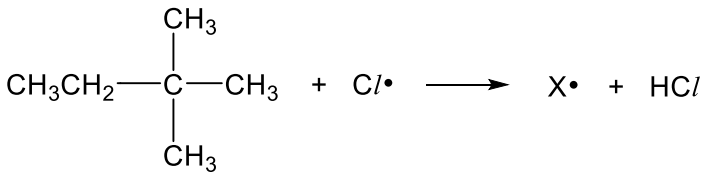


Lanosterol

How many stereoisomers does *Lanosterol* have?

A 2^6 **B** 2^7 **C** 2^8 **D** 2^9

18 When heated with chlorine, the hydrocarbon 2,2-dimethylbutane undergoes free radical substitution. In a propagation step, the free radical X• is formed by the loss of one hydrogen atom.



How many different forms of X• are theoretically possible?

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

19 Which compound will **not** be formed in the reaction between ethene and aqueous bromine in the presence of aqueous ammonia?

A CH_2BrCH_2Br

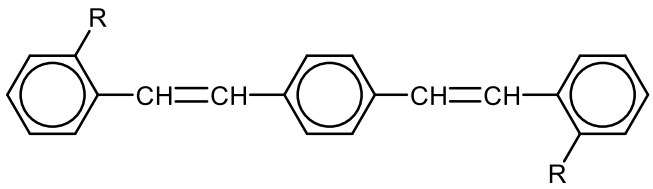
B CH_2BrCH_2OH

C $CH_2BrCH_2NH_2$

D $CH_2(OH)CH_2NH_2$

20 Compound X, which is used as an optical brightener in detergent, has the following structure.

Concepts in Q20 not tested in 2023 Promo



compound X

Assuming that –R represents a functional group which does not react with any of the reagents in the conditions stated below, which statements are correct?

1 X can undergo electrophilic addition with hydrogen.

2 Effervescence is observed when X is heated with acidified potassium manganate(VII).

3 X can be oxidised by cold alkaline potassium manganate(VII).

A 3 only

B 1 and 2 only

C 2 and 3 only

D 1 and 3 only

END OF PAPER