HWA CHONG INSTITUTION
C1 Promotional Examination
Higher 2

CANDIDATE NAME		**CT GROUP**	**22S**

CHEMISTRY

9729/01

Paper 1 Multiple Choice

28 September 2022

Additional Materials: Multiple Choice Answer Sheet

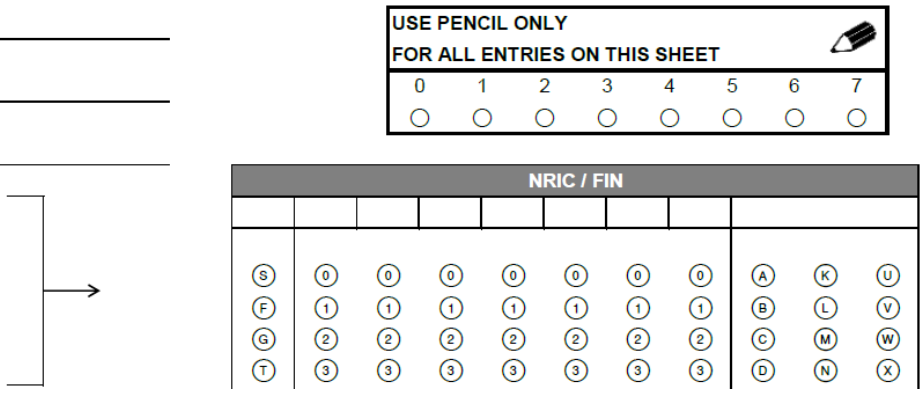
Data Booklet

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

Nuclear theories predict the number of protons and the number of neutrons that give especially stable nuclei. These numbers are known as the nuclear magic numbers. These numbers include

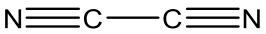
2, 8, 20, 28, 50, 82, 126.

The most stable nuclei are the 'doubly magic' ones that have a magic number of protons and a magic number of neutrons.

Using this theory, which isotope is the most stable?

A ^{2}He **B** ^{8}Be **C** ^{40}Ca **D** ^{210}Pb

2 Cyanogen, $(CN)_2$, is a colorless, toxic gas with a pungent smell.



cyanogen

Which statements about the cyanogen molecule are correct?

1 It contains two lone pairs of electrons.

2 It contains sp hybridized carbon atoms.

3 It contains a total of four π bonds and two σ bonds.

A 1 and 2 only

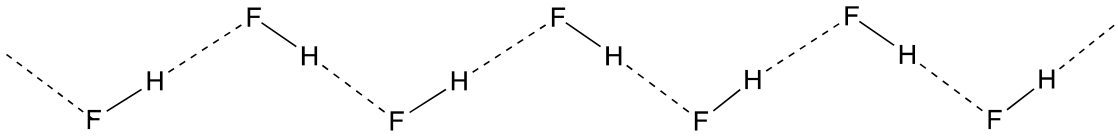
B 1 and 3 only

C 2 and 3 only

D 1 only

3 In the solid phase, molecules of hydrogen fluoride, HF, are held together by hydrogen bonding in a regular arrangement like water molecules in ice. The bond angle around the F atom is also similar to that around the O atom in ice.

However, each HF molecule forms only two hydrogen bonds with neighboring HF molecules in zig-zag chains as shown:



Which statement about solid HF is correct?

A Solid HF has the same open structure as in ice.

B Each hydrogen bond in solid HF is stronger than that in ice.

C The bond angle around each F atom is approximately 120°.

D The chains form part of a giant covalent structure in solid HF.

4 A flask of fixed volume contains a mixture of nitrogen gas and oxygen gas.

Which changes would apply when some helium gas is introduced into the flask at constant temperature?

1 The total pressure of gas in the flask would increase.

2 The mole fractions of nitrogen gas and oxygen gas would decrease.

3 The partial pressures of nitrogen gas and oxygen gas would increase.

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1 only

5 Which statements about empirical and molecular formula are correct?

1 The empirical formula for sodium chloride is NaC*l* and there is no molecular formula for sodium chloride.

2 H_2O represents both the empirical and molecular formula of water.

3 The empirical formula for propene is CH_2 while its molecular formula is C_3H_6.

A 1 only

B 1 and 2 only

C 2 and 3 only

D 1, 2 and 3 only

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

Which of the following contains the smallest number of particles?

A the number of atoms in 15 g of Fe metal

B the number of ions in 50 g of solid NaC*l*

C the number of molecules in 15 dm^3 of N_2 gas at r.t.p

D the number of molecules in 10 cm^3 of liquid hexane, C_6H_{14} (density = 6.55 g cm^{-3})

7 Which equations do **not** illustrate the enthalpy changes stated?

1 $N(g) + 3H(g) \rightarrow NH_3(g)$ $\Delta H^{\ominus}_{formation}(NH_3)$

2 $\frac{1}{2}Br_2(g) \rightarrow Br(g)$ $\Delta H^{\ominus}_{bond\ energy}(Br{-}Br)$

3 $Mg(s) \rightarrow Mg^+(g) + e^-$ $\Delta H^{\ominus}_{ionisation\ energy}(Mg)$

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

8 Calcium chloride is commonly used to prevent ice formation in cold climates.

enthalpy change	value in kJ mol^{-1}
lattice energy of $CaCl_2$	−2195
hydration enthalpy of Ca^{2+} ion	−1577
hydration enthalpy of Cl^- ion	−363

Given the data above, what is the enthalpy change of solution of calcium chloride?

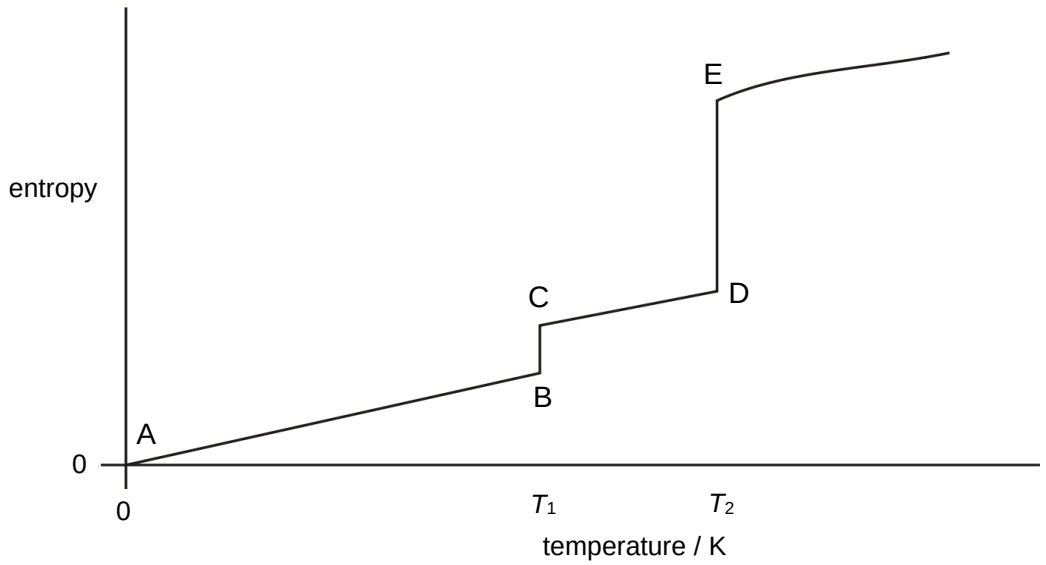
A −255 kJ mol^{-1}

B −108 kJ mol^{-1}

C +108 kJ mol^{-1}

D +255 kJ mol^{-1}

9 The sketch below shows how the entropy of a sample of water varies with temperature.



Which statement about the sketch is correct?

A The particles are most disordered at point A.

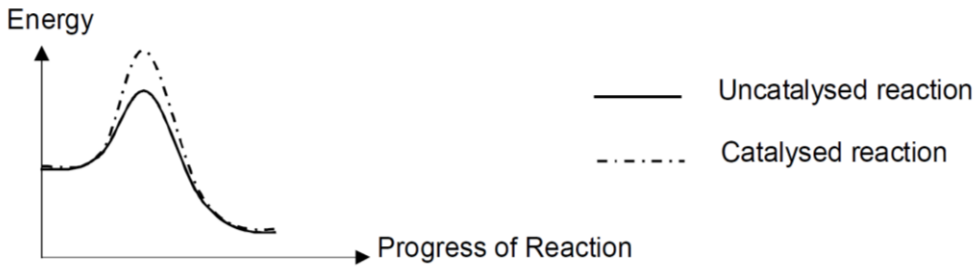
B The system is at dynamic equilibrium between points C and D.

C Entropy increases at BC because the particles possess greater average kinetic energy.

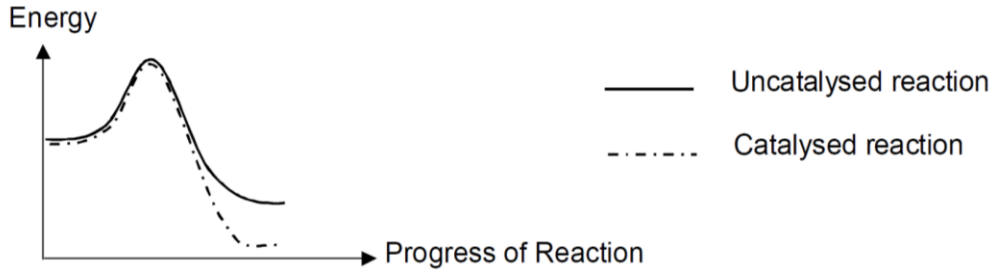
D Entropy increases more at DE compared to at BC because gas particles have a greater degree of disorder compared to liquid particles.

10 Which energy profile diagram shows the correct changes when a catalyst is added to a reaction?

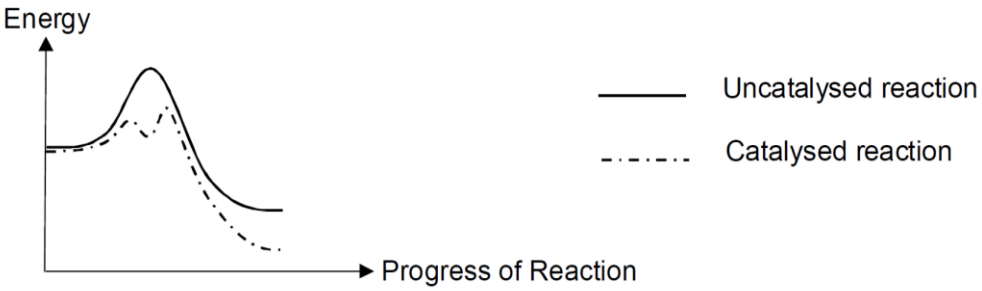
A



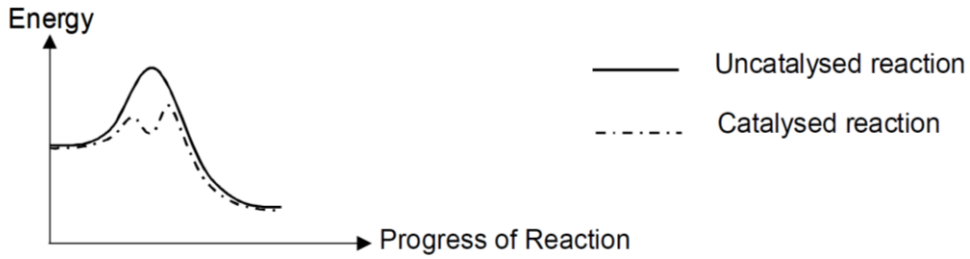
B



C



D



11 242-Curie and 248-Berkelium are radioactive isotopes of man-made elements which have a half-life of 160 days and 320 days respectively.

How many days would it take for a sample containing a 4:1 ratio of 242-Curie to 248-Berkelium to decay until the two isotopes are in a 1:1 ratio?

A 320 **B** 480

C 640 **D** 1280

12 When light is shone for a fixed period into a solution of CH_2ICH_2I and I_2 in CCl_4 solvent at 100 °C, the following reaction occurs.

$$CH_2ICH_2I \rightarrow CH_2{=}CH_2 + I_2$$

experiment	relative initial concentration		relative light intensity	relative initial rate of formation of I_2
	CH_2ICH_2I	I_2		
1	2	1	4	2
2	2	1	1	1
3	1	1	4	1
4	1	2	4	1

From the data in the table, the rate of formation of iodine is

1 proportional to $\sqrt{\text{light intensity}}$.

2 independent of initial concentration of I_2.

3 proportional to initial concentration of CH_2ICH_2I.

A 1 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3 only

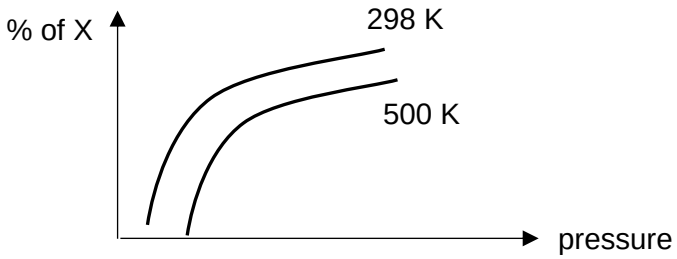
13 A reaction involving P, Q and R is allowed to reach equilibrium with the following equilibrium concentrations:

	2P(aq)	+	Q(aq)	⇌	2R(aq)
equilibrium concentration / mol dm^{-3}	2.0		1.0		2.0

When 0.5 mol of P was then added to 1 dm^3 of this equilibrium mixture, what will be the new equilibrium concentration, in mol dm^{-3}, for each species?

A	[P] = 2.5	[Q] = 1.25	[R] = 1.5
B	[P] = 2.0	[Q] = 0.75	[R] = 2.5
C	2 < [P] < 2.5	0 < [Q] < 1	2 < [R] < 2.5
D	1.5 < [P] < 2.0	0 < [Q] < 0.5	2.5 < [R] < 3.5

14 The graph below shows how the percentage of a substance, X, produced in an equilibrium mixture varies with pressure at temperatures 298 K and 500 K.



Which of the equilibria would X represent the underlined species?

A $2NI_3(s) \rightleftharpoons \underline{N_2}(g) + 3I_2(g)$ $\Delta H = -290$ kJ mol^{-1}

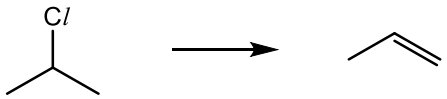
B $SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons \underline{SO_3}(g)$ $\Delta H = -198$ kJ mol^{-1}

C $H_2(g) + CO(g) \rightleftharpoons \underline{H_2O}(g) + C(s)$ $\Delta H = +131$ kJ mol^{-1}

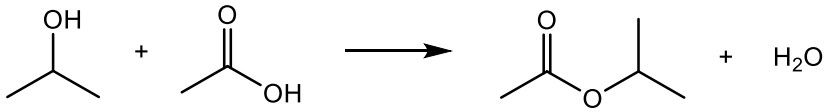
D $Fe_3O_4(s) + 4H_2(g) \rightleftharpoons 3\underline{Fe}(s) + 4H_2O(g)$ $\Delta H = +151$ kJ mol^{-1}

15 Which transformation correctly represents the type of reaction stated?

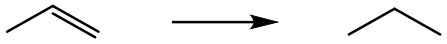
A addition



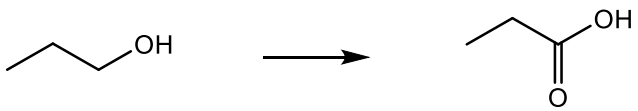
B elimination



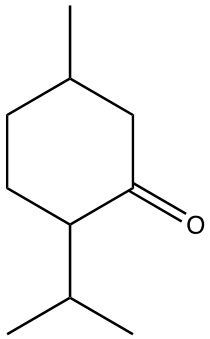
C reduction



D substitution



16 Menthone is a component in mint oil.



menthone

Which statements about menthone are correct?

1 It has a molecular formula of $C_{10}H_{18}O$.

2 It has a maximum of 4 stereoisomers.

3 The carbon bonded to the oxygen is a nucleophilic site.

A 1 and 2 only

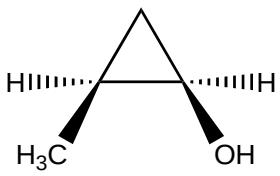
B 1 and 3 only

C 2 and 3 only

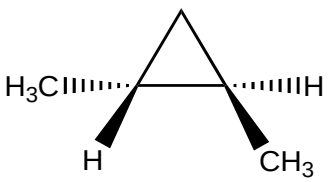
D 1, 2 and 3 only

17 Which molecule is **not** optically active?

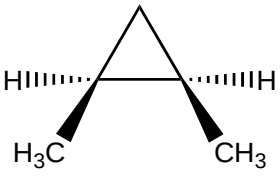
A



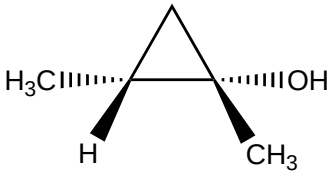
B



C



D



18 CH_4 and Cl_2 react together in the presence of ultraviolet light.

Which statements are correct?

1 Hydrogen gas is produced.

2 Bond breaking occurs only in the initiation step.

3 CH_3Cl is formed in the propagation and termination steps.

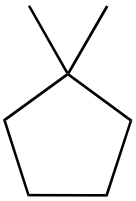
A 3 only

B 1 and 2 only

C 2 and 3 only

D 1, 2 and 3 only

19 1,1-dimethylcyclopentane undergoes free-radical substitution with limited bromine in the presence of ultraviolet light. A mixture of mono-brominated products is obtained.



1,1-dimethylcyclopentane

Assuming that the reaction occurs at the same rate at every carbon atom, what is the total number of mono-brominated products (ignore stereoisomers) obtained?

A 2 **B** 3 **C** 4 **D** 6

20 Exhaust fumes from car engines contain pollutant gases which can be removed with the use of a catalytic converter.

Which statements about the reactions occurring in the catalytic converter are correct?

1 Carbon monoxide is removed by reduction.

2 Oxides of nitrogen are removed by reduction.

3 Unburnt hydrocarbons are removed by oxidation.

A 1 only

B 1 and 2 only

C 2 and 3 only

D 1, 2 and 3 only

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