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南洋女子學校
NANYANG GIRLS' HIGH SCHOOL
End-of-Year Examination 2018
Secondary Three

Chemistry

Paper 1

Multiple Choice

Monday

8 October 2018

45 minutes

0845-0930

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, class and register number on the Multiple Choice Answer Sheet provided.

There are **thirty** questions in 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 Multiple Choice Answer Sheet.

INFORMATION FOR CANDIDATES

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 approved scientific calculators is allowed.

A copy of the Periodic Table is found on page 11.

This document consists of 11 printed pages and 1 blank page.

Setter: CDT

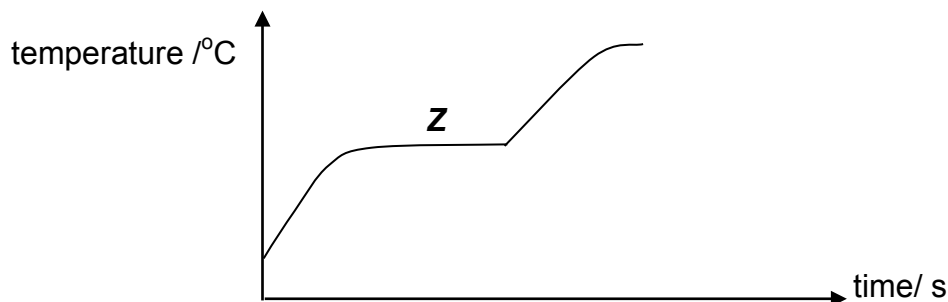
NANYANG GIRLS' HIGH SCHOOL

[Turn over]

- 1 Which of the following substances **A** to **D** undergoes a physical change when cooled from 25 °C to 0 °C?

substance	melting point/°C	boiling point/°C
A	-185	-165
B	-25	5
C	50	250
D	-5	65

- 2 A solid sample of octadecanoic acid ($C_{17}H_{35}COOH$) was heated until it started to melt.



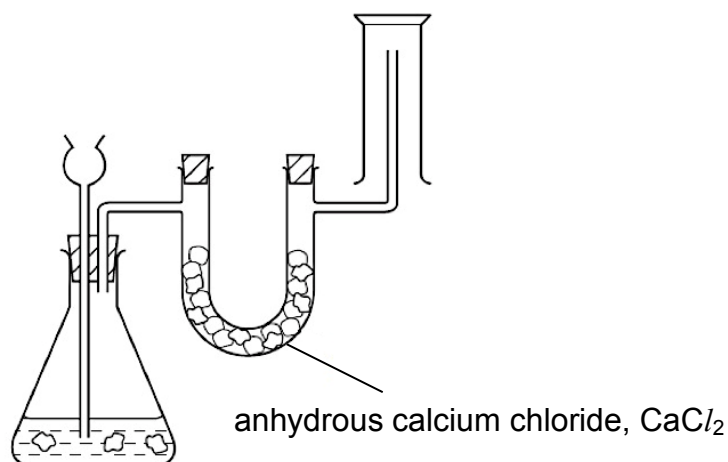
Which of the following statements best explains the shape of the graph at region **Z**?

- A** There was no heat energy supplied by the electrical heater.
B The molecules do not have any kinetic energy.
C A chemical reaction occurred during the melting process.
D Heat energy is used to overcome the attractive forces between the molecules.
- 3 Which of the following mixtures of substances can be separated using a separating funnel?
- A** ammonium chloride in lead(II) nitrate solution
B potassium iodide solution in organic solvent, trichloromethane, $CHCl_3(l)$
C sodium nitrate and potassium nitrate in water
D zinc oxide in water
- 4 Lead(II) sulfate is soluble in hot water but almost insoluble in cold water.

Which of the following methods is most suitable for obtaining a pure sample of lead(II) sulfate crystals from a flask containing a hot aqueous solution of lead(II) sulfate and sodium sulfate?

- A** cool the mixture to room temperature, filter and collect the residue
B heat the mixture and collect the substance which boils and condense it
C cool the mixture, filter and evaporate the filtrate
D heat the mixture and collect the substance in the flask

- 5 The diagram below shows an experimental set-up for the preparation and collection of a pure and dry sample of a gas.



Which of the following gases can be prepared and dried by this approach?

- A carbon dioxide, CO_2
 - B hydrogen, H_2
 - C hydrogen chloride, HCl
 - D nitrogen dioxide, NO_2
- 6 The table below shows information about four indicators used in acid-base titrations.

indicator	pH at which colour change takes place	colour at low pH	colour at high pH
methyl orange	3.2 to 4.4	red	yellow
bromocresol green	3.8 to 5.4	yellow	blue
methyl red	4.8 to 6.0	red	yellow
bromothymol blue	6.0 to 7.6	yellow	red

Which set of indicators is most accurate in demonstrating that a solution has a pH between 4.5 and 4.7 when added to separate samples of the solutions?

- A bromocresol green
 - B methyl red
 - C methyl red and bromothymol blue
 - D methyl red and methyl orange
- 7 Which of the following is a correct definition of a strong acid?
- A It reacts rapidly with weak bases in aqueous solution.
 - B It reacts completely with weak bases in a neutralisation reaction.
 - C It releases a large amount of heat when dissolved in water.
 - D It ionises completely into mobile ions when dissolved in water.

8 The following are three reactions of dilute aqueous sulfuric acid.

- (1) $\text{H}_2\text{SO}_4(\text{aq}) + \text{MgO}(\text{s}) \rightarrow \text{MgSO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- (2) $\text{H}_2\text{SO}_4(\text{aq}) + 2\text{K}(\text{s}) \rightarrow \text{K}_2\text{SO}_4(\text{aq}) + \text{H}_2(\text{g})$
- (3) $\text{H}_2\text{SO}_4(\text{aq}) + \text{BaCl}_2(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{HCl}(\text{aq})$

In which of the reactions is sulfuric acid **not** behaving as an acid?

- A (1) only
- B (3) only
- C (1) and (2) only
- D (2) and (3) only

9 Which of the following options below shows the correct methods used to prepare the following salts?

	titration	precipitation	adding excess solid reactants
A	ammonium nitrate	lead(II) sulfate	sodium chloride
B	barium carbonate	calcium sulfate	magnesium chloride
C	barium sulfate	ammonium chloride	lead(II) nitrate
D	potassium nitrate	silver iodide	zinc sulfate

10 Which of the following ionic equations suggests that the transition metal oxide, **MO**, is amphoteric?

- A $\text{MO}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{M}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq})$
- B $\text{MO}(\text{s}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{MO}_2^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- C $\text{MO}(\text{s}) + 2\text{H}^{+}(\text{aq}) \rightarrow \text{M}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- D $\text{MO}(\text{s}) + 2\text{NH}_4^{+}(\text{s}) \rightarrow \text{M}^{2+}(\text{s}) + \text{H}_2\text{O}(\text{l}) + 2\text{NH}_3(\text{g})$

11 A bottle containing solid lead(II) hydroxide has been contaminated with some solid copper(II) hydroxide.

How can lead(II) hydroxide be obtained from the mixture?

- A add boiling water to the mixture and filter
- B add aqueous ammonia to the mixture and filter
- C add warm dilute nitric acid to the mixture and filter
- D add warm aqueous sodium hydroxide to the mixture and filter

- 15 Talc is an ionic mineral which when crushed forms talcum powder. It has the formula $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$.

What is the charge on the silicate group $[\text{Si}_4\text{O}_{10}]$?

- A 2+
- B 4+
- C 2-
- D 4-

- 16 Deuterium (chemical symbol D) is an isotope of hydrogen containing 1 neutron. It can be represented by the symbol ${}^2_1\text{D}$.

Which of the following statements about deuterium oxide ('heavy water'), D_2O , is correct?

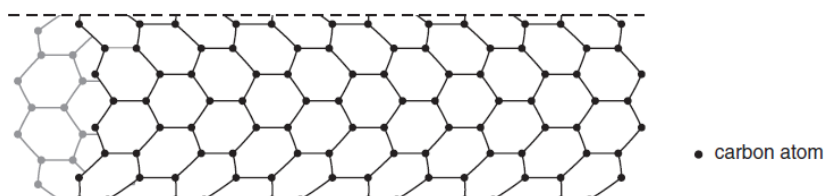
- A D_2O has a molar mass of 18.0 g mol^{-1} .
- B D_2O turns anhydrous copper(II) sulfate blue.
- C D_2O is a colourless gas at room temperature and pressure.
- D D_2O molecules are linear.

- 17 An ion of element X has an electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$ and a charge of 2+. It contains 48 neutrons.

Which of the following shows a **different** isotope of element X?

- A ${}^{86}_{36}\text{X}$
- B ${}^{88}_{36}\text{X}$
- C ${}^{86}_{38}\text{X}$
- D ${}^{88}_{38}\text{X}$

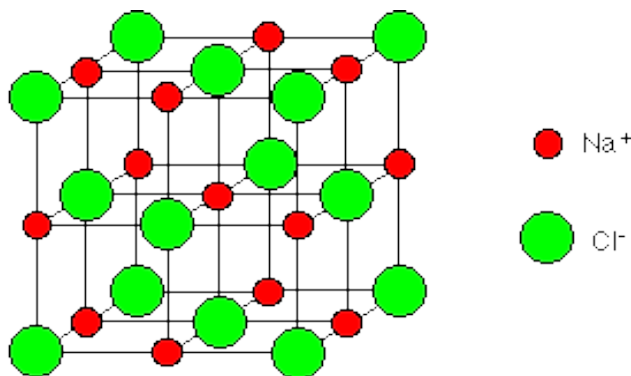
- 18 Long single-walled carbon nanotubes have been synthesised by scientists in recent years. A short part of the structure is shown below:



Which one of the following properties is most likely to be a property of a sample of carbon nanotubes?

- A It is strong.
- B It is highly soluble in water.
- C It is a poor conductor of electricity.
- D It has low melting point.

- 19 The diagram shows the cubic lattice of sodium chloride, NaCl, with ions packed together in a 1:1 ratio.



Which of the following statements is correct about its structure and bonding?

- A A negatively charged chloride ion will be attracted to all the positively charged sodium ions in the lattice.
- B An ionic bond is the sharing of a valence electron between a sodium atom and a chlorine atom.
- C A sodium ion is electrostatically bonded only to the chloride ion which it donates its electron to.
- D One sodium ion and one chloride ion neutralise each other's charges and form a sodium chloride molecule.
- 20 Which of the following statements is **incorrect** about iodine, I₂?
- A A crystal of iodine contains covalent bonds and intermolecular forces.
- B Iodine is a non-polar molecule.
- C The first ionisation energy of iodine is greater than that of bromine.
- D Atoms of iodine can form the iodide ion, I⁻.
- 21 What is the number of carbon atoms in 0.400 mol of glucose molecules, C₆H₁₂O₆?
- A 2.40
- B 9.60
- C 2.40×10^{23}
- D 1.44×10^{24}
- 22 50.0 cm³ of 2.50 mol dm⁻³ chloric(VII) acid, HClO₄, is diluted with water to a total volume of 500 cm³. Chloric(VII) acid is a strong monobasic acid.

What is the concentration of hydrogen ions, H⁺(aq), in the diluted solution?

- A 0.00625 mol dm⁻³
- B 0.0125 mol dm⁻³
- C 0.125 mol dm⁻³
- D 0.250 mol dm⁻³

- 23** The empirical formula of a compound is C_2H_4O . Which of the following chemical formulae are possible for this compound?

- (1) CH_3COOH
- (2) $CH_3CH_2CH_2COOH$
- (3) $CH_3COOCH_2CH_3$

- A** (1) and (2) only
- B** (1) and (3) only
- C** (2) and (3) only
- D** (1), (2) and (3)

- 24** Calcium carbonate decomposes on strong heating as shown below.



When 50.1 g of pure calcium carbonate is partially decomposed, 5.61 g of calcium oxide is formed.

What is the percentage yield of calcium oxide?

- A** 5.00%
- B** 10.0%
- C** 15.0%
- D** 20.0%

- 25** Which of the following groups of oxides is arranged in order of decreasing percentage by mass of carbon?

- A** C_3O_2 , CO , CO_2
- B** CO_2 , CO , C_3O_2
- C** CO , CO_2 , C_3O_2
- D** CO , C_3O_2 , CO_2

- 26** Hydrocarbons are compounds that contains hydrogen and carbon only. On reaction with excess oxygen, a sample of a hydrocarbon produces 66.0 g of carbon dioxide and 36.0 g of water.

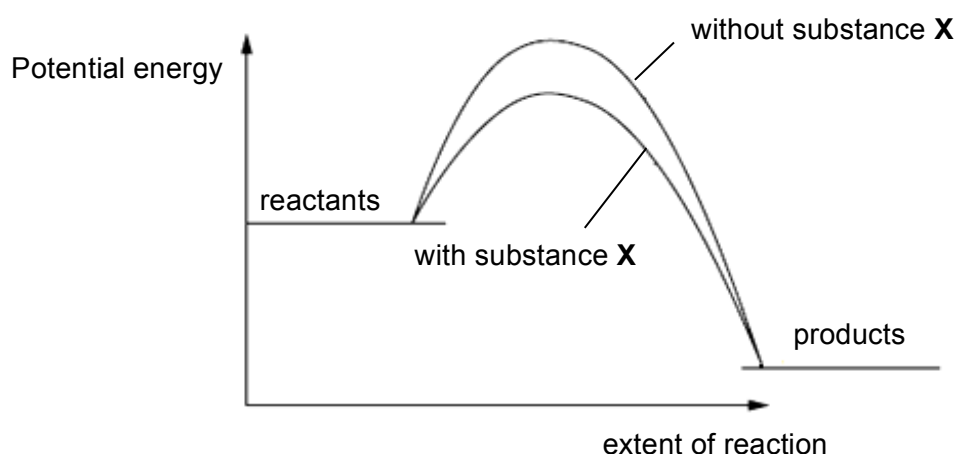
What is the molecular formula of this hydrocarbon?

- A** C_2H_2
- B** C_2H_4
- C** C_3H_4
- D** C_3H_8

- 27 Copper(II) sulfate can be prepared by reacting dilute sulfuric acid with excess copper(II) oxide.

Which of the following variables, if changed, would **not** change the rate of reaction?

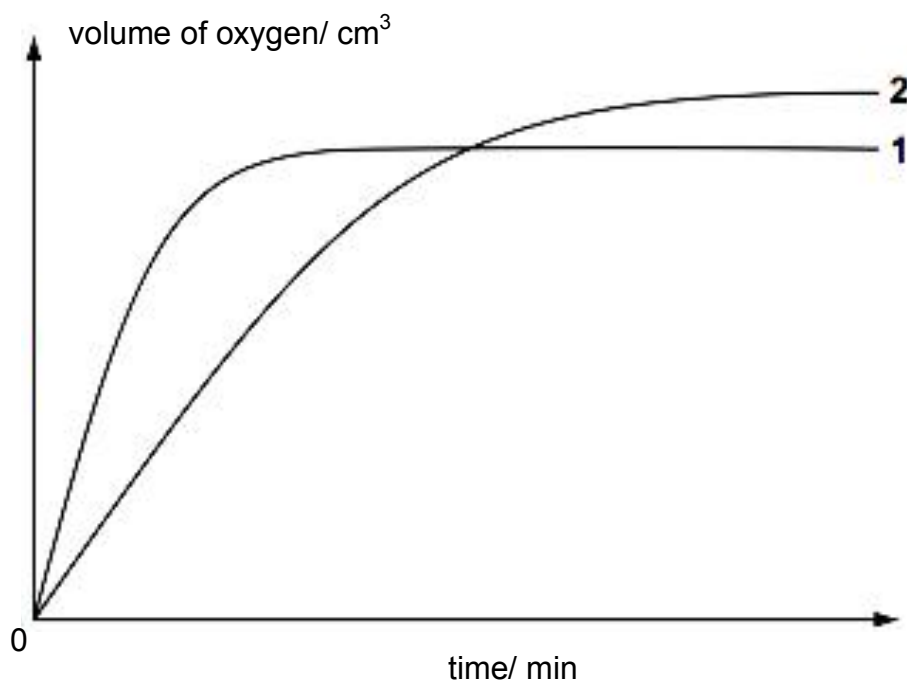
- A concentration of the sulfuric acid solution
 - B temperature of the sulfuric acid solution
 - C pressure of the surrounding air
 - D surface area of the particles of copper(II) oxide
- 28 The energy profile diagram shows how adding a small amount of substance **X** to a reaction mixture changes the reaction pathway.



Which change will be observed when **X** is added to the reaction mixture?

- A A smaller amount of heat will be released during the reaction.
 - B The percentage yield of products will increase.
 - C The rate of reaction will increase.
 - D **X** will undergo a permanent chemical change.
- 29 Which of the following statements about reaction kinetics are **false**?
- (1) Rates of reaction decrease linearly with time.
 - (2) Reactant molecules must be aligned and collided with a minimum amount of kinetic energy before they can react.
 - (3) Fast reactions generally have high activation energies.
 - (4) The rate of reaction is fastest at the start.
- A (1) and (3) only
 - B (1) and (4) only
 - C (2) and (4) only
 - D (1), (3) and (4) only

- 30** In the graph below, curve 1 was obtained by monitoring the decomposition of 100 cm^3 of 1.00 mol dm^{-3} of hydrogen peroxide solution, catalysed by manganese(IV) oxide.



Which of the following changes to the original experimental conditions would produce curve 2?

- A** decreasing the temperature of the reaction mixture
- B** adding an additional 15.0 cm^3 of 0.100 mol dm^{-3} hydrogen peroxide solution to the 100 cm^3 of 1.00 mol dm^{-3} hydrogen peroxide solution
- C** using less manganese(IV) oxide
- D** using a different transition metal oxide catalyst

End of paper

The Periodic Table of Elements

Group																					
1	2	1 H hydrogen 1.0														13	14	15	16	17	18
		Key																			
		atomic number atomic symbol name relative atomic mass																			
3 Li lithium 6.9	4 Be beryllium 9.0	5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2	11 Na sodium 23.0	12 Mg magnesium 24.3	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9						
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8				
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium —	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3				
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium —	85 At astatine —	86 Rn radon —				
87 Fr francium —	88 Ra radium —	89–103 actinoids	104 Rf rutherfordium —	105 Db dubnium —	106 Sg seaborgium —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —	114 Fl flerovium —	116 Lv livermorium —	118 Og oganeson —	119 Ts tennessine —	120 Nh nihonium —	121 Fl flerovium —				
lanthanoids																					
57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.2	61 Pm promethium —	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.3	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.1	71 Lu lutetium 175.0							
actinoids																					
89 Ac actinium —	90 Th thorium 232.0	91 Pa protactinium 231.0	92 U uranium 238.0	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkelium —	98 Cf californium —	99 Es einsteinium —	100 Fm fermium —	101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —							

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