# SECONDARY 4 INTEGRATED PROGRAMME END OF YEAR ASSESSMENT 2020

### CHEMISTRY Paper 1

2 October 2020

1 hour

## READ THESE INSTRUCTIONS FIRST

Write your name, register number, and class on the OAS sheet using a soft pencil.

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers A, B, C and D. Choose the correct answer and record the corresponding letter using a soft pencil on the OAS sheet. Amendments may be done using a soft eraser.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. A calculator may be used.

## A copy of Periodic Table is provided on page 2.

The total number of marks for this paper is 40.

For Examiner's Use					
Total (40)					

This document consists of 18 printed pages.



圣尼各拉女校 CHIJ ST. NICHOLAS GIRLS' SCHOOL

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6092 CHEMISTRY GCE ORDINARY LEVEL SYLLABUS (2018)

# The Periodic Table of Elements

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The volume of one mole of any gas is  $24\,dm^3$  at room temperature and pressure (r.t.p.).

1 An excess of dilute sulfuric acid was added to a sample of sodium sulfite, Na<sub>2</sub>SO<sub>3</sub> crystals and the following reaction occurred:

 $Na_2SO_3 + H_2SO_4 \rightarrow SO_2 + Na_2SO_4 + H_2O$ 

The gas evolved was then dried and collected using a suitable method.



What is the most suitable drying agent and gas collection method that can be used to obtain a dry sample of the gas evolved?

	drying agent	gas collection method
Α	anhydrous copper(II) sulfate	gas syringe
В	calcium oxide	downward delivery
С	calcium oxide	water displacement
D	concentrated sulfuric acid	upward delivery

2 The melting and boiling points of substances X and Y are given below.

substance	melting point/ °C	boiling point/ °C
Х	801	1465
Y	15	86

Which is the most suitable method to separate X and Y at room temperature and pressure?

- A crystallisation
- **B** filtration
- **C** fractional distillation
- **D** simple distillation

**3** An experiment was carried out to separate two components in a mixture using chromatography with water as the solvent.

The chromatogram below shows the result of the experiment.



Keeping all other conditions the same, what can be done to prevent the two components from overlapping with each other?

- **A** Allow the solvent front to travel a shorter distance.
- **B** Draw the start line lower so that it will be submerged in the solvent.
- **C** Ensure the spot of the mixture is smaller at the initial position on the start line.
- **D** Use a longer chromatogram and allow the solvent front to travel the same distance.
- 4 Ammonium perchlorate has a formula of NH<sub>4</sub>C*l*O<sub>4</sub>. What is the formula of iron(III) perchlorate?
  - A FeClO<sub>4</sub>
  - **B** Fe(C/O<sub>4</sub>)<sub>3</sub>
  - C Fe<sub>3</sub>C/O<sub>4</sub>
  - **D**  $FeH_4(ClO_4)_3$

**5** A sample of liquid ammonia is collected in a flask and analysed. Which of the following best describes the particles present in the flask?

	particles in motion	movement of	spacing between
		particles	particles
Α	ammonia molecules	slide and roll	randomly arranged in
			clusters
В	ammonia molecules	moving in all direction	far apart
С	ammonium ions and hydroxide ions	moving in all direction	far apart
D	ammonium ions and hydroxide ions	slide and roll	randomly arranged in clusters

6 At room temperature and pressure, balloons P and Q are each filled up with a different gas until both have the same volume. When the two balloons are allowed to sit inside an air-tight tank filled with nitrogen gas for a while, balloon P increased significantly in size while balloon Q decreased significantly in size.

What could be the gases inside balloon P and Q?

	gas in balloon P	gas in balloon Q
Α	argon	fluorine
В	carbon monoxide	ammonia
С	hydrogen	nitrogen dioxide
D	oxygen	neon

7 The cooling curve of chloroform, CHC/<sub>3</sub> is given below.



Which of the following regarding chloroform is true?

- A At the 5th minute, there is only gaseous chloroform present.
- **B** At 0 °C, chloroform is undergoing condensation.
- **C** At the 12th minute, chloroform molecules lose energy to become closer.
- **D** At -70 °C, chloroform consists of ions that can only vibrate at fixed positions.

8 Which of the following substances boils at a sharp temperature and can be broken down into simpler substances by chemical means?



**9** Particle **L** has the following nuclide notation.

Particle **M** has 1 more proton, 1 more electron and 2 more neutrons than particle **L**. Which of the following statements about particle **M** is true?

- **A** It contains 14 neutrons.
- B It is an ion.
- **C** It has an electronic configuration of 2,8,4.
- **D** It has the same chemical properties as particle **L**.
- **10** An element, X has two isotopes:
  - The first has 16 neutrons and a relative abundance of 80%
  - The second isotope has a proton number of 15 and mass number of 32

What is the relative atomic mass of this element?

- A 15.6B 15.8
- **C** 19.2
- **D** 31.2

**11** The structure of a substance is shown below:



What could be the identity of elements W, X and Y?

	W	Х	Y
Α	aluminium	lead	magnesium
В	carbon	nitrogen	oxygen
С	nitrogen	carbon	hydrogen
D	nitrogen	carbon	sulfur

- 12 Z is the atomic number of a noble gas in the Periodic Table. The atomic numbers of the elements X and Y are (Z+3) and (Z-2) respectively. Which is the most likely formula of the compound formed between X and Y?
  - **A** X<sub>2</sub>Y<sub>3</sub>
  - **B** X<sub>3</sub>Y<sub>2</sub>
  - **C** Y<sub>2</sub>X<sub>3</sub>
  - **D** Y<sub>3</sub>X<sub>2</sub>
- **13** The table below gives some information on substances W, X, Y and Z.

substance	melting	boiling	electrical c	solubility in	
	point / °C	point / °C	as solid	as liquid	water
W	17	118	poor	poor	soluble
Х	455	1547	poor	good	insoluble
Y	1064	2970	good	good	insoluble
Z	3550	4830	poor	poor	insoluble

Which of the following statements is likely to be true?

- **A** W has a simple covalent structure.
- **B** X has a giant metallic structure.
- **C** Y has the same physical properties as SiO<sub>2</sub>.
- **D** Z is held together by electrostatic forces between oppositely charged ions.

- **14** Under the same temperature and pressure, a 24 g of sample of oxygen gas occupies the same volume as 18 g of gas P. What is the relative molecular mass of gas P?
  - **A** 12
  - **B** 24
  - **C** 32
  - **D** 56
- **15** Which of the following metal samples contains the largest number of electrons in its "sea of delocalized electrons"?
  - A 1 g of barium
  - **B** 1 g of lithium
  - **C** 0.1 mole of sodium
  - **D** 0.1 mole of magnesium
- **16** The shell of a quail egg makes up 2 % of the mass of an average quail egg. An average quail egg has a mass of 15 g. Assuming that the quail egg shell is made up of pure calcium carbonate, what is the volume of 1.0 mol/dm<sup>3</sup> hydrochloric acid that is needed to react with 10 quail eggs completely?
  - **A** 0.003 dm<sup>3</sup>
  - **B** 0.006 dm<sup>3</sup>
  - **C** 0.030 dm<sup>3</sup>
  - **D** 0.060 dm<sup>3</sup>
- **17** 3.0 g of impure magnesium is added to 150 cm<sup>3</sup> of 2.0 mol/dm<sup>3</sup> dilute hydrochloric acid. What is the percentage purity of magnesium if only 2.4 dm<sup>3</sup> of hydrogen gas was produced at the end of the reaction?
  - **A** 41.7 %
  - **B** 60.0 %
  - **C** 80.0 %
  - **D** 83.3 %
- **18** Which of the following statements about Group I metals is **incorrect**?
  - A All Group I metals can react with cold water and the resultant solution turns red litmus paper blue.
  - **B** Their melting point decreases down the group.
  - **C** Their reducing power increases down the group.
  - **D** When Group I metals are exposed to air, they react to form a grey metal oxide that is insoluble in water.

### 19 Element X

- has a density of 19.25 g/cm<sup>3</sup>
- forms oxides with chemical formulae XO<sub>2</sub> and XO<sub>3</sub>
- has the ability to conduct electricity in solid state

What is the possible identity of element X?

- **A** lithium
- B sulfur
- **C** tungsten
- D zinc
- **20** In separate experiments conducted, three different Group VII halogens were mixed into aqueous solutions of two unknown aqueous halide compounds. The following results were observed.

halogen	halide	solution
	Y⁻ (aq)	Z <sup>-</sup> (aq)
X2	no observable	no observable reaction
	reaction	
Y <sub>2</sub>	no observable	colour change observed
	reaction	
Z <sub>2</sub>	no observable	no observable reaction
	reaction	

Using the information above, arrange halogens X, Y, Z in order of increasing reactivity.

Α	X, Z, Y
В	Y, Z, X
С	Z, X, Y
D	Z, Y, X

**21** A substance NaXO<sub>4</sub> undergoes a chemical reaction with hydrogen peroxide, according to the following equation:

 $2NaXO_4 + 3H_2SO_4 + 5H_2O_2 \rightarrow 2XSO_4 + Na_2SO_4 + 8H_2O + 5O_2$ 

What is the role of hydrogen peroxide in the above reaction?

- **A** It acts as a catalyst.
- **B** It is a dehydrating agent.
- **C** It is an oxidizing agent.
- **D** It is a reducing agent.

- 22 Which of the following options shows that substance X is oxidised?
  - A After adding aqueous X to acidified potassium manganate(VII), a purple solution is observed.
  - **B** Adding aqueous potassium bromide to aqueous X gives a reddish brown colour.
  - **C** Adding pale yellow iron(III) solution to aqueous X gives a pale green colour.
  - **D**  $XO_3^- \rightarrow XO^- + O_2$
- 23 Which of the following statements about strong and weak acids is true?
  - **A** A weak dibasic acid will always have a faster rate of reaction as compared to a strong monobasic acid of the same concentration.
  - **B** For the same basicity and concentration, weak acids have a lower pH than strong acids.
  - **C** Regardless of strength, monobasic acids of the same concentration and volume require the same number of moles of aqueous sodium hydroxide for complete neutralization.
  - **D** There are no mobile OH<sup>-</sup> ions present in all types of aqueous acids.
- 24 Which reagent can be used to demonstrate that zinc oxide is amphoteric?
  - **A** hydrochloric acid
  - **B** sodium hydroxide
  - **C** universal indicator
  - D water

indicator	colour change	approximate pH range
	(low pH $\rightarrow$ high pH)	for colour change
methyl orange	red $\rightarrow$ yellow	3.1 - 4.4
bromocresol	yellow → blue	3.8 - 5.4
green		
phenophthalein	colourless → pink	8.0 - 9.0

Titration is carried out between aqueous sodium hydroxide and aqueous ethanoic acid. The pH change is plotted on the graph shown below.



Which indicator(s) can be used to identify the end point of this titration?

- A bromocresol green only
- **B** methyl orange only
- **C** phenolphthalein only
- **D** phenolphthalein and bromocresol green only
- 26 When visible pieces of calcium oxide are added to dilute sulfuric acid, the solids do not seem to disappear completely even after excess acid is added with stirring. What is the best explanation for this observation?
  - A Heat is required for the reaction to proceed further.
  - **B** The oxide cannot be reduced by carbon or hydrogen.
  - **C** The acid reacts with calcium sulfate instead of calcium oxide.
  - **D** The reaction forms a sulfate coating, preventing further contact with acid.

**25** The chart below shows the colours of three indicators at different pH values:

- 27 Which of the following salts can be prepared using the same method?
  - **A** zinc chloride, calcium sulfate
  - B potassium iodide, lead(II) iodide
  - **C** copper(II) sulfate, lead(II) nitrate
  - D ammonium chloride, magnesium nitrate
- 28 When aqueous barium nitrate was added into an unknown solution, a white precipitate was formed. Subsequently, dilute nitric acid was added dropwise to the resultant mixture until in excess. Effervescence was observed and the white precipitate dissolved completely.

Based on the observations, suggest what could be present in the unknown solution.

- **A** aluminium sulfate
- **B** ammonium chloride
- **C** copper(II) carbonate
- **D** sodium carbonate
- 29 The table shows information on the enthalpy of combustion of different fuels.

fuel	enthalpy of combustion in
	kJ/mol
hydrogen	-286
methane, CH4	-880
ethane, C <sub>2</sub> H <sub>6</sub>	-1560

Which statements are correct?

- 1 Methane produces more heat than hydrogen for each gram of fuel burned.
- 2 On complete combustion, 1 mole of propane, C<sub>3</sub>H<sub>8</sub>, will release more than 1560 kJ of energy.
- 3 When hydrogen is completely combusted, the energy absorbed for bond breaking is more than the energy released in bond forming.
- A 2 only
- **B** 3 only
- **C** 2 and 3 only
- **D** 1, 2 and 3

**30** A diagram for the energy change during a chemical reaction is shown.



Which of the following reactions could be represented by this energy diagram?

- 1.  $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
- 2.  $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
- 3.  $2C + O_2 \rightarrow 2CO$
- A 1 only
- **B** 2 only
- **C** 1 and 3 only
- **D** 1, 2 and 3
- **31** In experiment 1, 1.00 g of calcium carbonate powder is added to 200 cm<sup>3</sup> of 0.100 mol/dm<sup>3</sup> dilute hydrochloric acid at 25 °C. The volume of gas produced is plotted against time as shown by Graph X below.

The experiment is then repeated using 100 cm<sup>3</sup> of 0.200 mol/dm<sup>3</sup> dilute hydrochloric acid keeping all other conditions the same as experiment 1.

Which of the following graphs could be obtained for the second experiment?



**32** The table below shows the results of tests carried out to determine the reactivity of metals X, Y and Z.

test	metal X	metal Y	metal Z
Does its carbonate decompose on heating?	yes	no	yes
Does the metal react with hydrochloric acid?	yes	yes	no

Which of the following shows the correct order of reactivity of the metals?

	most reactive $\rightarrow$ least reactive			
Α	Х	Y	Z	
В	Y	Х	Z	
С	Z	Х	Y	
D	Z	Y	Х	

**33** An unknown gas X is passed over heated solid Y, as shown below.



Which of the following pairs of reactants will undergo a chemical reaction?

	gas X	solid Y
Α	carbon monoxide	calcium oxide
В	carbon dioxide	zinc oxide
С	hydrogen	iron(III) oxide
D	steam	lead

**34** Three strips of the same metal were dipped into three different aqueous solutions containing CuSO<sub>4</sub>, MgSO<sub>4</sub> and Fe(NO<sub>3</sub>)<sub>2</sub> respectively.

A metallic deposit was observed on the metallic strips dipped into the  $CuSO_4$  and  $Fe(NO_3)_2$  solutions.

What could the metal be?

- A Ca
- B Fe
- C Pb
- D Zn

35 In which of the following setups will the iron nail not rust after one week?



36 Which simple cell set-up would produce the greatest reading on the voltmeter?



**37** The circuit shown is set up and an electric current is passed through the four cells in series.

In which cells is the intensity of the blue colouration of the solution unchanged?



- A W and Z
- B X and Y
- C X and Z
- D Y and Z

38 Methanol can be used as a fuel in a Direct Methanol Fuel Cell (DMFC).



It has the following half equations:

Left electrode:  $CH_3OH + H_2O \rightarrow 6H^+ + 6e^- + CO_2$ Right electrode:  $3O_2 + 12H^+ + 12e^- \rightarrow 6H_2O$ 

Which of the following statements about DMFC is true?

- A 1 moles of methanol will react with 3 moles of oxygen.
- **B** The overall reaction in the DMFC is endothermic.
- **C** The right electrode is the anode.
- **D** When 2 moles of methanol are used, the overall reaction produces 4 moles of water.
- **39** Ammonia is produced by the Haber process.

Which of the statements regarding Haber process is true?

- 1 Nickel is added as a catalyst.
- 2 Hydrogen can be obtained by fractional distillation of liquefied air.
- 3 Ammonia may decompose to form hydrogen and nitrogen.
- A 2 only
- B 3 only
- C 1 and 3 only
- D 2 and 3 only

**A** NO, NO<sub>2</sub>, SO<sub>2</sub>

40

- **B** HC*l*, NO, CH<sub>4</sub>
- **C** CO, NO<sub>2</sub>, CH<sub>4</sub>
- **D** HC*l*, NO<sub>2</sub>, SO<sub>2</sub>

End of Paper 1