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| Class | Register Number | Name |
|-------|-----------------|------|



南洋女子中学校  
**NANYANG GIRLS' HIGH SCHOOL**  
**End-of-Year Examination 2020**  
**Secondary Three**

**Chemistry**

**Paper 1**

Multiple Choice

**Wednesday**

**07 October 2020**

**45 minutes**

**1130-1215**

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**

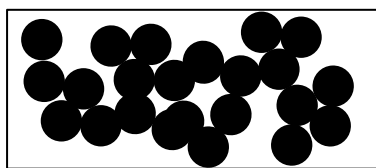
Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

The use of approved scientific calculators is allowed.

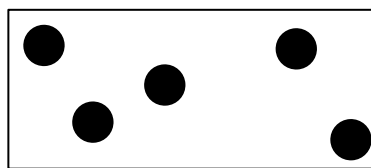
A copy of the Periodic Table is found on page 13.

|            |                                                                                                   |                   |
|------------|---------------------------------------------------------------------------------------------------|-------------------|
| Setter: KO | This document consists of 13 printed pages and 1 blank page.<br><b>NANYANG GIRLS' HIGH SCHOOL</b> | <b>[Turn over</b> |
|------------|---------------------------------------------------------------------------------------------------|-------------------|

- 1 The diagrams below show the arrangement of particles of the same substance but at different temperatures.



at 10 °C

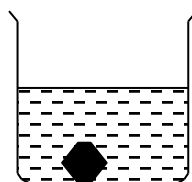


at 60 °C

Which one of the following is most likely to be the substance represented above?

|          | melting point /°C | boiling point /°C |
|----------|-------------------|-------------------|
| <b>A</b> | – 50              | – 10              |
| <b>B</b> | – 10              | 0                 |
| <b>C</b> | 0                 | 50                |
| <b>D</b> | 20                | 80                |

- 2 A copper(II) sulfate crystal is left in a beaker of water as shown below. After several days, a homogenous blue colouration was observed throughout the contents of the beaker.



What are the particles that moved to result in the blue colouration?

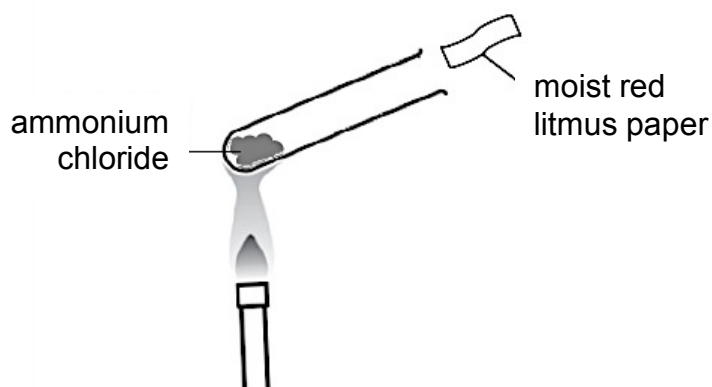
- A** copper(II) ions and sulfate ions only
  - B** copper(II) ions and water molecules only
  - C** water molecules and copper(II) sulfate molecules
  - D** copper(II) ions, sulfate ions and water molecules
- 3 Which process is suitable for obtaining the water from an aqueous solution of sugar?
- A** crystallisation
  - B** distillation
  - C** filtration
  - D** use of a separating funnel

4 What is the correct order of separating a mixture of the following solids, to obtain a pure sample of each compound?

- potassium chloride
- barium sulfate
- iodine

- A** sublimation, dissolving, filtering, evaporation  
**B** sublimation, dissolving, distillation, evaporation  
**C** dissolving, evaporation, filtering, sublimation  
**D** dissolving, distillation, sublimation, evaporation

5 When heated strongly in a hard glass test tube, ammonium chloride decomposes as follows:

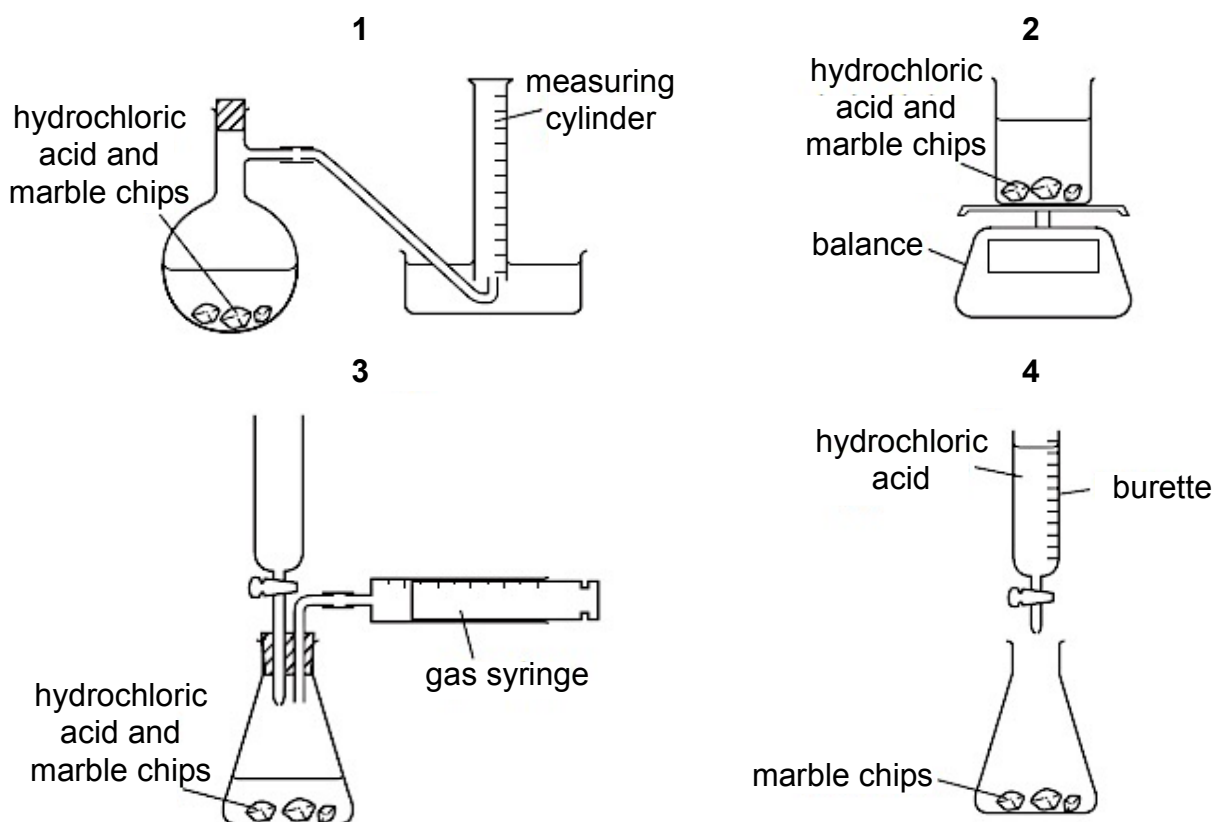


What happens to the moist red litmus paper?

- A** remains red  
**B** turns blue  
**C** turns blue then red again  
**D** bleaches

- 6 A student wants to carry out an experiment to follow the rate of reaction between hydrochloric acid and marble chips.

Which set-ups are suitable for this experiment?



- A 1 and 2  
B 2 and 3  
C 1 and 4  
D 1, 2 and 3
- 7 An indicator changes colour according to the table below.

| pH     | colour |
|--------|--------|
| 0 – 3  | red    |
| 4 – 7  | brown  |
| 8 – 14 | purple |

Which pair of solutions can be distinguished by this indicator?

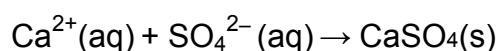
- A aqueous ammonia and potassium hydroxide  
B aqueous calcium chloride and water  
C aqueous potassium nitrate and potassium hydroxide  
D dilute sulfuric acid and dilute hydrochloric acid

- 8 Which statement about amphoteric oxides is not correct?
- A They dissolve in water.  
B They are all metallic oxides.  
C They react with aqueous hydrochloric acid to give salts.  
D They react with aqueous sodium hydroxide to give salts.
- 9 Which of the following sets of reagents is suitable for preparation of lead(II) sulfate?
- A lead, sulfuric acid  
B lead(II) carbonate, sulfuric acid  
C lead(II) oxide, nitric acid, sodium sulfate  
D lead(II) chloride, nitric acid, sodium sulfate
- 10 Separate tests on a sample of polluted water from a factory gave the following results.

| reagent added                           | observation(s)                                       |
|-----------------------------------------|------------------------------------------------------|
| barium nitrate followed by nitric acid  | white precipitate, insoluble in acid                 |
| nitric acid followed by aqueous ammonia | white precipitate, soluble in excess aqueous ammonia |

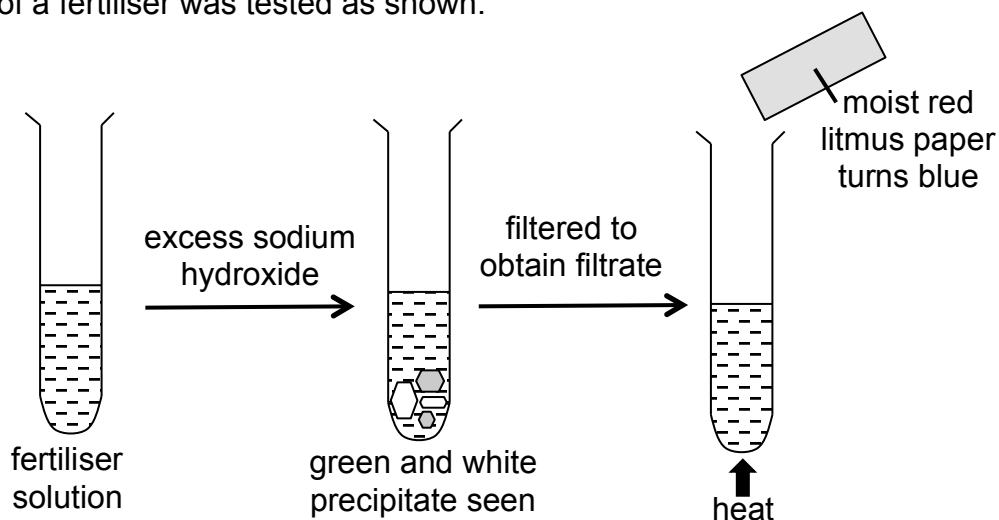
What compound could have been present in the polluted water?

- A zinc carbonate  
B aluminium sulfate  
C zinc sulfate  
D aluminium carbonate
- 11 Which of the following pairs of reagents when added together will have the following ionic equation?



- I aqueous calcium hydroxide and aqueous ammonium sulfate  
II aqueous calcium nitrate and aqueous sodium sulfate  
III aqueous calcium nitrate and dilute sulfuric acid  
IV aqueous calcium hydroxide and sulfuric acid
- A I and IV  
B II and III  
C I, II and III  
D I, II, III and IV

- 12 A solution of a fertiliser was tested as shown.



Which ions must be present in the fertiliser?

- A  $\text{Fe}^{2+}$ ,  $\text{Ca}^{2+}$  and  $\text{NO}_3^-$
  - B  $\text{Fe}^{3+}$ ,  $\text{Zn}^{2+}$  and  $\text{NO}_3^-$
  - C  $\text{Fe}^{2+}$ ,  $\text{Ca}^{2+}$  and  $\text{NH}_4^+$
  - D  $\text{Fe}^{3+}$ ,  $\text{Zn}^{2+}$  and  $\text{NH}_4^+$
- 13 In an experiment,  $20.0 \text{ cm}^3$  of  $1.0 \text{ mol dm}^{-3}$  of aqueous iron(III) nitrate was mixed with  $30 \text{ cm}^3$  of  $1.0 \text{ mol dm}^{-3}$  of aqueous sodium hydroxide.

What would you observe when the reaction was complete?

- A a green precipitate and a pale green solution
  - B a green precipitate and a colourless solution
  - C a reddish-brown precipitate and a yellow solution
  - D a reddish-brown precipitate and a pale green solution
- 14 An element **X** forms an ion with a charge of  $2+$ .  
 $0.65 \text{ g}$  of a metal **X** can completely react with  $20 \text{ cm}^3$  of  $1.0 \text{ mol dm}^{-3}$  of hydrochloric acid.

What is the relative atomic mass of this metal **X**?

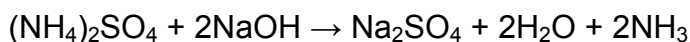
- A 23.0
- B 32.5
- C 55.8
- D 65.4

- 15** In a steel making process, the impurity  $P_4O_{10}$  is removed by reacting it with calcium oxide. The only product of this reaction is the salt calcium phosphate,  $Ca_3(PO_4)_2$ .

In this reaction, how many moles of  $P_4O_{10}$  react with three moles of calcium oxide?

- A** 0.5 mol
- B** 1.0 mol
- C** 1.5 mol
- D** 3.0 mol

- 16** 5.00 g of a fertiliser containing ammonium sulfate was dissolved in water and diluted to  $250\text{ cm}^3$ .  $25.0\text{ cm}^3$  of this solution was added to an excess of sodium hydroxide solution. The reaction between ammonium sulfate and sodium hydroxide is given by the following equation:



The ammonia produced was bubbled into  $50.0\text{ cm}^3$  of  $0.0500\text{ mol dm}^{-3}$  sulfuric acid solution. The resulting solution then required  $25.80\text{ cm}^3$  of  $0.100\text{ mol dm}^{-3}$  sodium hydroxide solution for complete neutralisation.

What is the percentage by mass of ammonium sulfate ( $M_r = 132.1$ ) in the fertiliser?

- A** 10.6%
  - B** 16.0%
  - C** 32.0%
  - D** 40.0%
- 17** Chlorine gas is a severe irritant to the eyes and respiratory system. The maximum safe toleration level of chlorine gas in air is  $0.00495\text{ mg dm}^{-3}$ . [ $1\text{ g} = 1000\text{ mg}$ ]

How many chlorine atoms are present in  $500\text{ cm}^3$  of air at this toleration level?

- A**  $4.20 \times 10^{16}$
- B**  $2.10 \times 10^{16}$
- C**  $2.98 \times 10^{18}$
- D**  $4.22 \times 10^{20}$

- 18** Skunks are mammals best known for their ability to excrete a strong, foul-smelling odour in order to ward off potential attackers. Methanethiol,  $\text{CH}_3\text{SH}$ , is a foul-smelling chemical which is found in the sprays of skunks.

A  $20\text{ cm}^3$  sample of methanethiol was exploded with  $80\text{ cm}^3$  of oxygen. What would be the final volume of the resultant mixture of gases when cooled to room temperature and pressure?



- A**  $40\text{ cm}^3$   
**B**  $60\text{ cm}^3$   
**C**  $70\text{ cm}^3$   
**D**  $80\text{ cm}^3$
- 19** In which one of the following does chlorine have the highest oxidation state?
- A**  $\text{Cl}_2$   
**B**  $\text{ClF}_3$   
**C**  $\text{HClO}_3$   
**D**  $\text{MgCl}_2$
- 20** Which of the following is a redox reaction?
- A**  $\text{ZnO} + \text{C} \rightarrow \text{CO} + \text{Zn}$   
**B**  $\text{ZnO} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2\text{O}$   
**C**  $\text{Zn}(\text{OH})_2 + 4\text{NH}_3 \rightarrow \text{Zn}(\text{NH}_3)_4^{2+} + 2\text{OH}^-$   
**D**  $\text{ZnSO}_4 + 2\text{NaOH} \rightarrow \text{Zn}(\text{OH})_2 + \text{Na}_2\text{SO}_4$
- 21** In an experiment involving a redox reaction, it was determined that  $0.654\text{ g}$  of zinc was completely oxidised by  $100\text{ cm}^3$  of  $0.1\text{ mol dm}^{-3}$  of vanadium(III) oxide,  $\text{VO}_2^+$ .

Which of the following vanadium compound is the product of the above reaction?

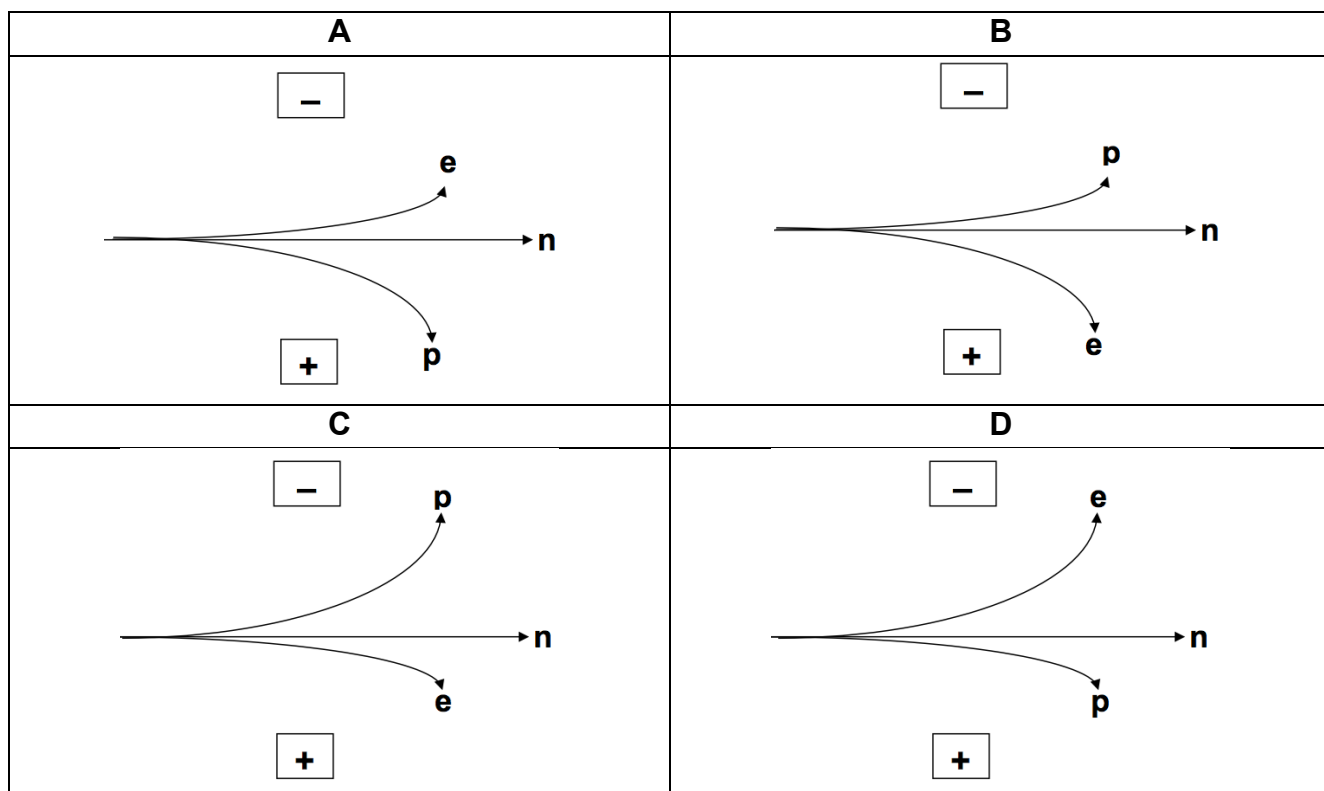
- A**  $\text{VO}^{2+}$   
**B**  $\text{VO}_3^-$   
**C**  $\text{V}_2\text{O}_3$   
**D**  $\text{V}_2\text{O}_5$

- 22** Sulfur dioxide is used as a preservative in wine making.  
The following equations show what happens when sulfur dioxide dissolves in water.



Which statement about these two reactions is correct?

- A**  $\text{HSO}_3^-$  acts as a base.  
**B**  $\text{SO}_2$  acts as an oxidising agent.  
**C**  $\text{SO}_3^{2-}$  acts as an acid.  
**D**  $\text{SO}_3^{2-}$  acts as a reducing agent.
- 23** An isotope of element **Z** has 17 protons and 18 neutrons in its nucleus. Which nuclide notation is correct for the ion of **Z**?
- A**  $^{18}_{17}\text{Z}^+$   
**B**  $^{35}_{17}\text{Z}^+$   
**C**  $^{18}_{17}\text{Z}^-$   
**D**  $^{35}_{17}\text{Z}^-$
- 24** Which of the following correctly shows the behaviour of the subatomic particles, protons (**p**), neutrons (**n**) and electrons (**e**) when passing through the positive and negative charged plates?



**25** Which of the following best describes the properties of carbon dioxide?

|          | melting point | boiling point | electrical conductivity |                  |
|----------|---------------|---------------|-------------------------|------------------|
|          |               |               | in liquid state         | in aqueous state |
| <b>A</b> | high          | high          | none                    | none             |
| <b>B</b> | high          | high          | good                    | good             |
| <b>C</b> | low           | low           | none                    | none             |
| <b>D</b> | low           | low           | none                    | good             |

**26** Element **P** and **Q** form a compound with formula **PQ<sub>3</sub>**. This compound exists as a liquid at room temperature.

What are the correct electron arrangements of atoms **P** and **Q**?

|          | <b>P</b> | <b>Q</b> |
|----------|----------|----------|
| <b>A</b> | 1        | 2.3      |
| <b>B</b> | 2.1      | 2.8.3    |
| <b>C</b> | 2.8.3    | 2.7      |
| <b>D</b> | 2.8.5    | 2.8.7    |

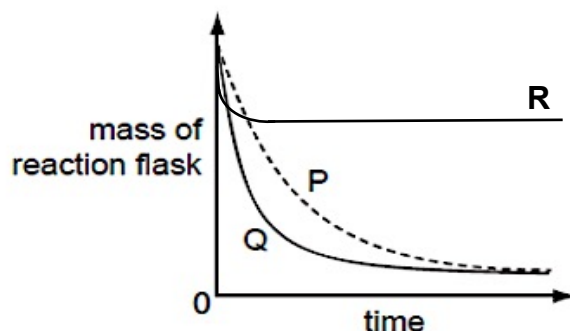
**27** An investigation of the properties of the third-period elements shows that the boiling points of sodium chloride and silicon tetrachloride are 1465°C and 57°C respectively.

What is the reason for the difference in boiling points?

- A** covalent bonds being weaker than ionic bonds
- B** silicon tetrachloride having weak intermolecular forces of attraction
- C** silicon forming weaker bonds with chlorine than does sodium
- D** sodium chloride having strong electrostatic attraction between its atoms

For questions **28** and **29**, please refer to the following.

A student investigates the rate of reaction between excess powdered calcium carbonate and hydrochloric acid. The loss in mass of the reaction flask is measured. Graph **P** shows the results of the experiment.



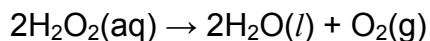
**28** Which change(s) would have resulted in the graph **Q**?

- A** increasing the pressure
- B** increasing the temperature
- C** using lumps of calcium carbonate
- D** increasing the concentration of hydrochloric acid

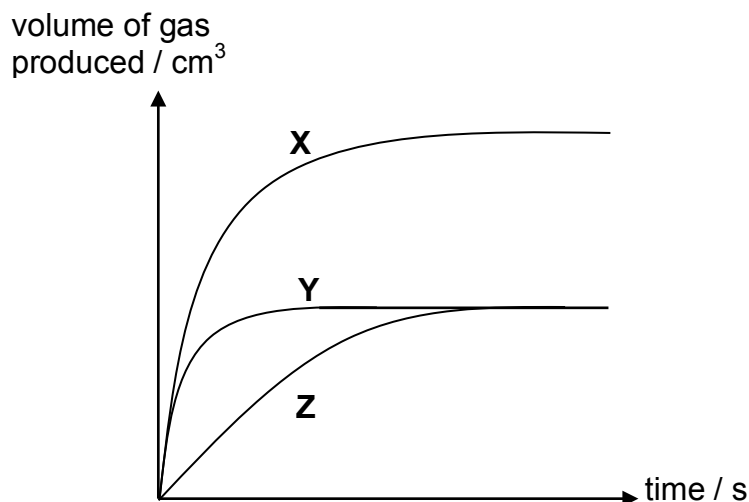
**29** Which change(s) would have resulted in the graph **R**?

- A** decrease the volume of hydrochloric acid
- B** decrease the mass of marble chips
- C** adding a catalyst
- D** replacing hydrochloric acid with sulfuric acid

**30** Manganese(IV) oxide catalyses the decomposition of hydrogen peroxide.



Three solutions of hydrogen peroxide were decomposed using a fixed mass of powdered manganese(IV) oxide. The results are given below:



The solutions used were:

- I        25 cm<sup>3</sup> of 2 mol dm<sup>-3</sup> hydrogen peroxide
- II       50 cm<sup>3</sup> of 2 mol dm<sup>-3</sup> hydrogen peroxide
- III      50 cm<sup>3</sup> of 1 mol dm<sup>-3</sup> hydrogen peroxide

Which one of the following correctly shows the above results?

|   | I | II | III |
|---|---|----|-----|
| A | X | Y  | Z   |
| B | Y | Z  | X   |
| C | Z | X  | Y   |
| D | Y | X  | Z   |

**End of paper**

The Periodic Table of Elements

| Group                        |  |                               |  |                                                                |  |                                 |  |                               |  |                                |  |                               |  |                                |  |                              |  |                                |  |                               |  |                               |  |                               |  |                               |  |                               |  |                                |  |                             |  |                             |  |
|------------------------------|--|-------------------------------|--|----------------------------------------------------------------|--|---------------------------------|--|-------------------------------|--|--------------------------------|--|-------------------------------|--|--------------------------------|--|------------------------------|--|--------------------------------|--|-------------------------------|--|-------------------------------|--|-------------------------------|--|-------------------------------|--|-------------------------------|--|--------------------------------|--|-----------------------------|--|-----------------------------|--|
| 1                            |  | 2                             |  | 13                                                             |  |                                 |  |                               |  |                                |  |                               |  |                                |  | 16                           |  | 17                             |  | 18                            |  |                               |  |                               |  |                               |  |                               |  |                                |  |                             |  |                             |  |
|                              |  |                               |  | 1<br>H<br>hydrogen<br>1.0                                      |  |                                 |  |                               |  |                                |  |                               |  |                                |  |                              |  |                                |  |                               |  |                               |  | 2<br>He<br>helium<br>4.0      |  |                               |  |                               |  |                                |  |                             |  |                             |  |
|                              |  |                               |  | Key                                                            |  |                                 |  |                               |  |                                |  |                               |  |                                |  |                              |  |                                |  |                               |  |                               |  |                               |  |                               |  |                               |  |                                |  |                             |  |                             |  |
|                              |  |                               |  | atomic number<br>atomic symbol<br>name<br>relative atomic mass |  |                                 |  |                               |  |                                |  |                               |  |                                |  |                              |  |                                |  |                               |  |                               |  |                               |  |                               |  |                               |  |                                |  |                             |  |                             |  |
| 3<br>Li<br>lithium<br>6.9    |  | 4<br>Be<br>beryllium<br>9.0   |  |                                                                |  |                                 |  |                               |  |                                |  |                               |  |                                |  |                              |  | 5<br>B<br>boron<br>10.8        |  | 6<br>C<br>carbon<br>12.0      |  | 7<br>N<br>nitrogen<br>14.0    |  | 8<br>O<br>oxygen<br>16.0      |  | 9<br>F<br>fluorine<br>19.0    |  | 10<br>Ne<br>neon<br>20.2      |  |                                |  |                             |  |                             |  |
| 11<br>Na<br>sodium<br>23.0   |  | 12<br>Mg<br>magnesium<br>24.3 |  |                                                                |  |                                 |  |                               |  |                                |  |                               |  |                                |  |                              |  | 13<br>Al<br>aluminium<br>27.0  |  | 14<br>Si<br>silicon<br>28.1   |  | 15<br>P<br>phosphorus<br>31.0 |  | 16<br>S<br>sulfur<br>32.1     |  | 17<br>Cl<br>chlorine<br>35.5  |  | 18<br>Ar<br>argon<br>39.9     |  |                                |  |                             |  |                             |  |
| 19<br>K<br>potassium<br>39.1 |  | 20<br>Ca<br>calcium<br>40.1   |  | 21<br>Sc<br>scandium<br>45.0                                   |  | 22<br>Ti<br>titanium<br>47.9    |  | 23<br>V<br>vanadium<br>50.9   |  | 24<br>Cr<br>chromium<br>52.0   |  | 25<br>Mn<br>manganese<br>54.9 |  | 26<br>Fe<br>iron<br>55.8       |  | 27<br>Co<br>cobalt<br>58.9   |  | 28<br>Ni<br>nickel<br>58.7     |  | 29<br>Cu<br>copper<br>63.5    |  | 30<br>Zn<br>zinc<br>65.4      |  | 31<br>Ga<br>gallium<br>69.7   |  | 32<br>Ge<br>germanium<br>72.6 |  | 33<br>As<br>arsenic<br>74.9   |  | 34<br>Se<br>selenium<br>79.0   |  | 35<br>Br<br>bromine<br>79.9 |  | 36<br>Kr<br>krypton<br>83.8 |  |
| 37<br>Rb<br>rubidium<br>85.5 |  | 38<br>Sr<br>strontium<br>87.6 |  | 39<br>Y<br>yttrium<br>88.9                                     |  | 40<br>Zr<br>zirconium<br>91.2   |  | 41<br>Nb<br>niobium<br>92.9   |  | 42<br>Mo<br>molybdenum<br>95.9 |  | 43<br>Tc<br>technetium<br>—   |  | 44<br>Ru<br>ruthenium<br>101.1 |  | 45<br>Rh<br>rhodium<br>102.9 |  | 46<br>Pd<br>palladium<br>106.4 |  | 47<br>Ag<br>silver<br>107.9   |  | 48<br>Cd<br>cadmium<br>112.4  |  | 49<br>In<br>indium<br>114.8   |  | 50<br>Sn<br>tin<br>118.7      |  | 51<br>Sb<br>antimony<br>121.8 |  | 52<br>Te<br>tellurium<br>127.6 |  | 53<br>I<br>iodine<br>126.9  |  | 54<br>Xe<br>xenon<br>131.3  |  |
| 55<br>Cs<br>caesium<br>132.9 |  | 56<br>Ba<br>barium<br>137.3   |  | 57–71<br>lanthanoids                                           |  | 72<br>Hf<br>hafnium<br>178.5    |  | 73<br>Ta<br>tantalum<br>180.9 |  | 74<br>W<br>tungsten<br>183.8   |  | 75<br>Re<br>rhenium<br>186.2  |  | 76<br>Os<br>osmium<br>190.2    |  | 77<br>Ir<br>iridium<br>192.2 |  | 78<br>Pt<br>platinum<br>195.1  |  | 79<br>Au<br>gold<br>197.0     |  | 80<br>Hg<br>mercury<br>200.6  |  | 81<br>Tl<br>thallium<br>204.4 |  | 82<br>Pb<br>lead<br>207.2     |  | 83<br>Bi<br>bismuth<br>209.0  |  | 84<br>Po<br>polonium<br>—      |  | 85<br>At<br>astatine<br>—   |  | 86<br>Rn<br>radon<br>—      |  |
| 87<br>Fr<br>francium<br>—    |  | 88<br>Ra<br>radium<br>—       |  | 89–103<br>actinoids                                            |  | 104<br>Rf<br>rutherfordium<br>— |  | 105<br>Db<br>dubnium<br>—     |  | 106<br>Sg<br>seaborgium<br>—   |  | 107<br>Bh<br>bohrium<br>—     |  | 108<br>Hs<br>hassium<br>—      |  | 109<br>Mt<br>meitnerium<br>— |  | 110<br>Ds<br>darmstadtium<br>— |  | 111<br>Rg<br>roentgenium<br>— |  | 112<br>Cn<br>copernicium<br>— |  | 114<br>Fl<br>flerovium<br>—   |  | 116<br>Lv<br>livermorium<br>— |  | 117<br>Ts<br>tennessine<br>—  |  | 118<br>Og<br>oganesson<br>—    |  | 119<br>Nh<br>nihonium<br>—  |  | 120<br>Dh<br>dubnium<br>—   |  |

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