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南洋女子中學校
Nanyang Girls' High School

End-of-Year Examination 2021 Secondary 3

IP CHEMISTRY

Paper 1 Multiple Choice

Wednesday 6 October

Additional Materials: Multiple Choice Answer Sheet

45 minutes
1130 – 1215

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, register number and class in the spaces at the top of this page and on the Answer Sheet in the spaces provided.

There are **thirty** 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.

Read the instructions on the Answer Sheet very carefully.

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

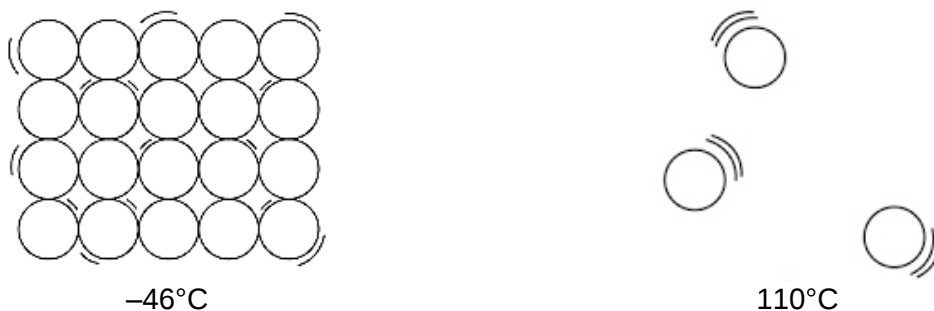
Any rough working should be done in this booklet.

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

The use of approved scientific calculators is expected, where appropriate.

This document consists of **13** printed pages and **1** blank page.

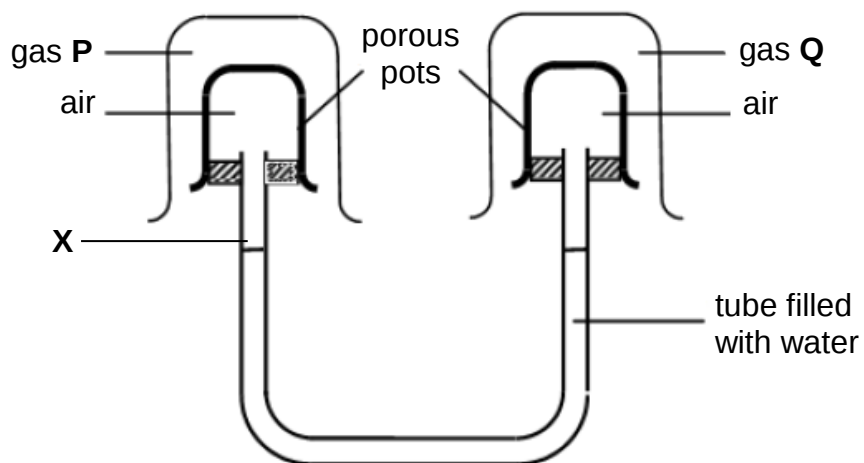
- 1 The diagrams show the particles in substance **M** at two different temperatures.



What could be the melting point and boiling point of substance **M**?

	melting point / $^{\circ}\text{C}$	boiling point / $^{\circ}\text{C}$
A	-40	130
B	-35	80
C	-60	100
D	-70	140

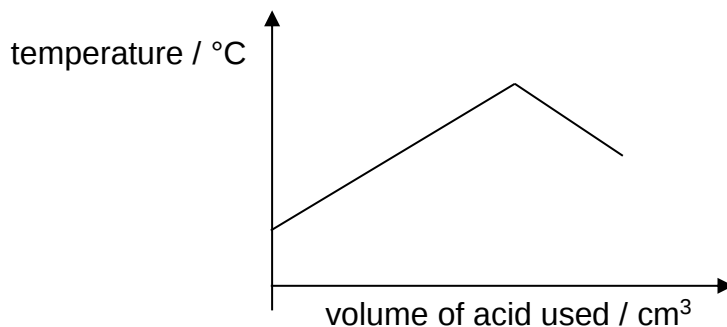
- 2 The diagram shows an experiment involving two gases, **P** and **Q**, contained in inverted beakers. You may assume that the effect caused by the solubility of the gases in water is negligible.



Which combination of gases would cause the level at **X** to decrease?

	gas P	gas Q
A	carbon dioxide	helium
B	carbon monoxide	nitrogen
C	ammonia	nitrogen dioxide
D	chlorine	methane

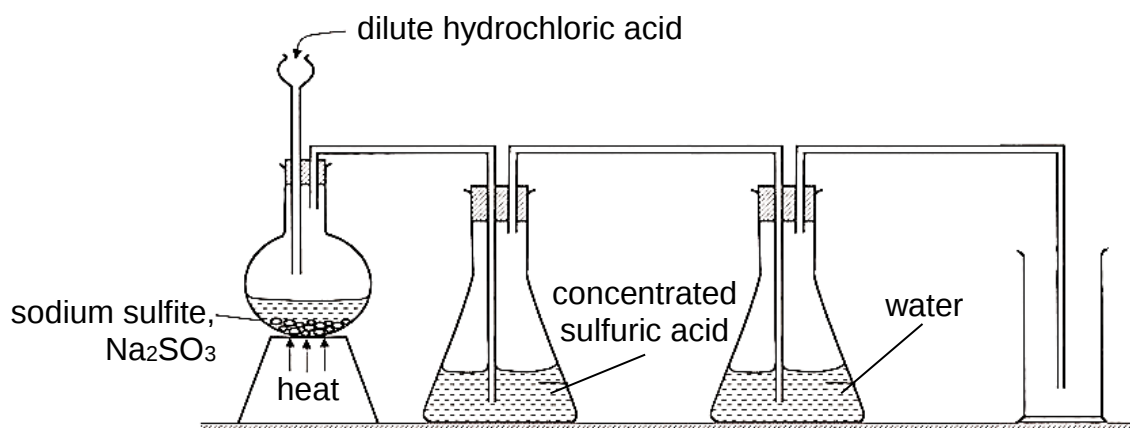
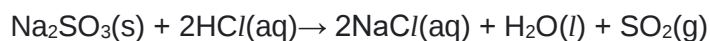
- 3 An experiment was carried out to measure the amount of heat produced in the reaction of hydrochloric acid with potassium hydroxide. The result was presented in the following graph.



Which pair of apparatus was used to measure the variables shown on the graph?

	independent variable	dependent variable
A	burette	thermometer
B	thermometer	burette
C	pipette	thermometer
D	thermometer	pipette

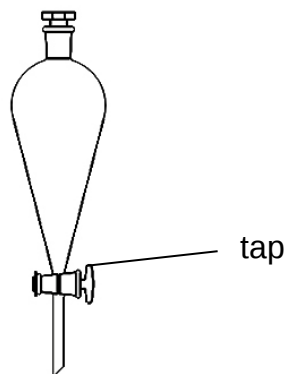
- 4 The set up below was used by a student to prepare pure, dry sulfur dioxide gas in the laboratory according to the reaction below.



What change needs to be made for the gas to be collected successfully?

- A** Collect the gas using displacement of water instead.
- B** Collect the gas using upward delivery instead.
- C** Remove the conical flask filled with water.
- D** Replace concentrated sulfuric acid with concentrated potassium hydroxide.

- 5 An apparatus used in separating mixtures is shown below.



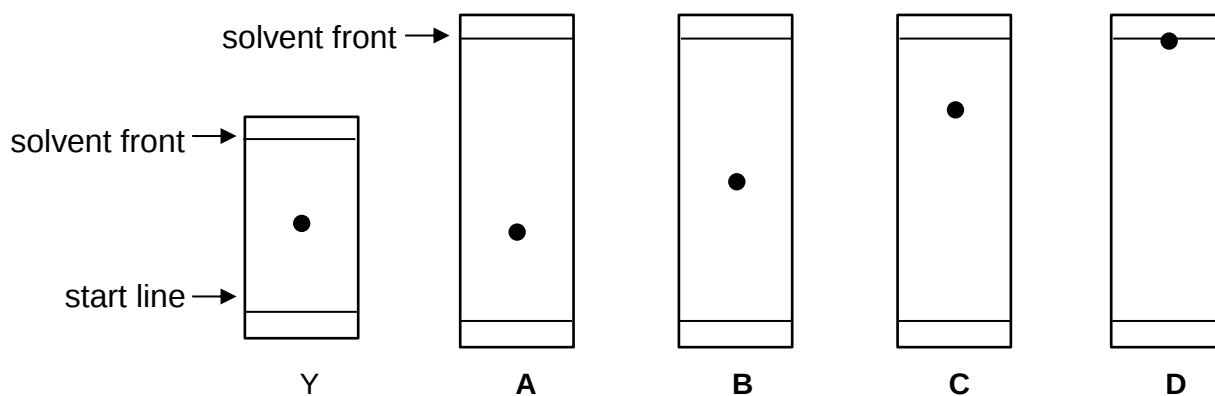
Which statements are correct about the apparatus?

- 1 It is used in the separation of miscible liquids.
- 2 When the tap is opened, the substance with a higher density is collected first.
- 3 Carbon disulfide, an organic solvent, can be separated from water using this apparatus.

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

- 6 A dye was analysed using paper chromatography and chromatogram Y was obtained as shown on the left. The same chromatogram was developed using the same solvent with a longer piece of paper.

Which chromatogram, **A** to **D**, would most likely be obtained?



- 7 The table shows the number of protons, neutrons and electrons in four ions.

Which row shows the correct number of sub-atomic particles?

	ion	number of		
		protons	neutrons	electrons
A	${}^{40}_{20}\text{Ca}^{2+}$	20	20	20
B	${}^{19}_9\text{F}^{-}$	8	10	8
C	${}^{18}_8\text{O}^{2-}$	10	8	12
D	${}^{23}_{11}\text{Na}^{+}$	11	12	10

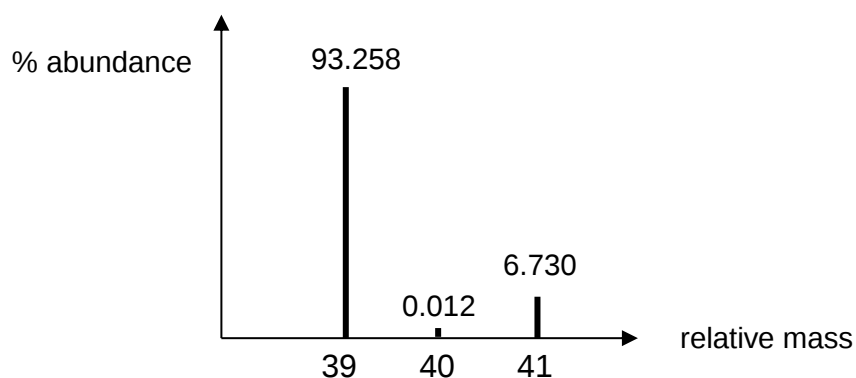
- 8 Elements **X**, **Y** and **Z** are arranged consecutively in the Periodic Table. **X**, **Y** and **Z** are not symbols of the respective elements.

Two pieces of information about the elements are written below.

- 1 Atoms of **X** have 7 valence electrons.
- 2 The subshell with the highest energy level in an atom of **Y** is 3p.

Which of the following statements about the elements is true?

- A **X** and **Z** form a compound with the formula **XZ₂**.
 B The relative atomic mass of **Y** is lower than **Z**.
 C Atom **Z** has 1 electron in its 3d subshell.
 D **Z** has more metallic character than **X**.
- 9 Potassium has three stable isotopes: ${}^{39}\text{K}$, ${}^{40}\text{K}$ and ${}^{41}\text{K}$. The percentage abundance of each isotope is represented in the graph below.



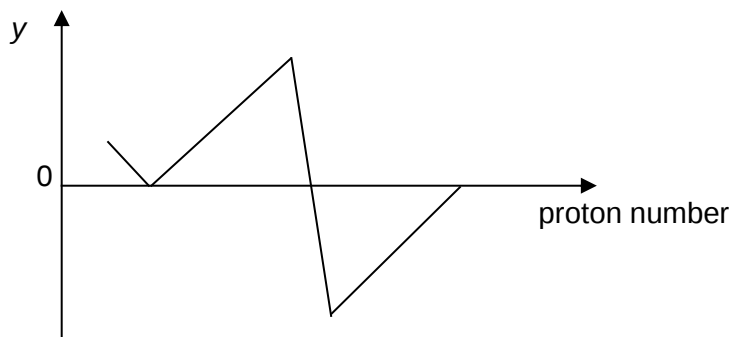
What is the relative atomic mass of potassium?

- A 39.08
 B 39.10
 C 39.13
 D 39.14

10 Which statement best explains why a H^{2-} ion cannot be formed?

- A H^{2-} ion is larger than H^+ ion.
- B H^{2-} ion has 2 more electrons than H^+ ion.
- C Hydrogen can only form positive ions.
- D The 1s subshell of hydrogen can only contain a maximum of 2 electrons.

11 The graph below shows a trend for the first ten elements in the Periodic Table.



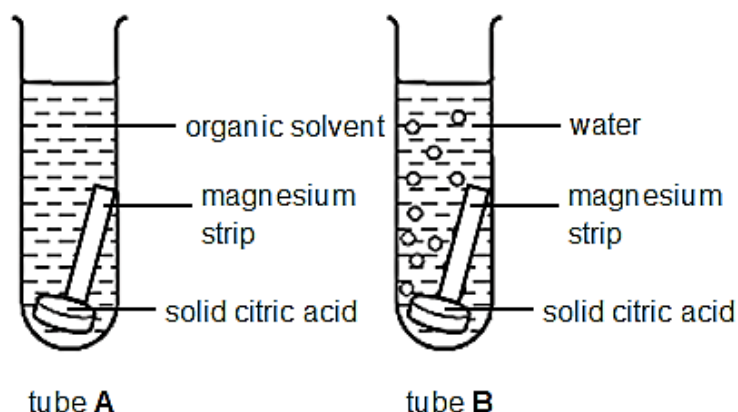
What could y be?

- A ionic charge
 - B nucleon number
 - C number of electron shells
 - D number of unpaired electrons
- 12 Which statement best explains why farmers should **not** add slaked lime, $\text{Ca}(\text{OH})_2$, and ammonium nitrate fertiliser to the soil at the same time?
- A It is not economically viable to add two substances to the soil at the same time.
 - B The slaked lime will dissolve and make the soil strongly alkaline.
 - C The slaked lime will react with the ammonium nitrate to result in a loss of nitrogen-containing nutrients from the fertiliser.
 - D The slaked lime will react with the ammonium nitrate to produce acid which inhibits plant growth.
- 13 Sodium carbonate reacted with dilute hydrochloric acid at room temperature and pressure to form sodium chloride and some other products.

Which is the correct ionic equation for the reaction above?

- A $\text{CO}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$
- B $\text{CO}_3^-(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$
- C $\text{Na}_2\text{CO}_3(\text{s}) + 2\text{H}^+(\text{aq}) \rightarrow 2\text{Na}^+(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$
- D $\text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{NaCl}(\text{aq})$

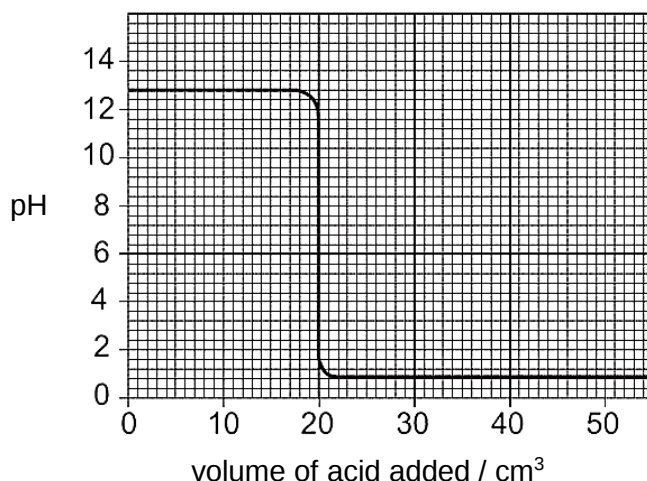
- 14 Two test tubes, **A** and **B**, each contain a magnesium strip, solid citric acid, and different solvents.



Effervescence was observed in tube **B** but not in tube **A**.

What can be concluded from both experiments?

- A** Only water can be used as a solvent for any chemical reaction.
B Organic solvents do not produce hydrogen ions.
C Solid citric acid ionises in water to produce hydrogen ions.
D Water ionises to produce hydrogen ions.
- 15 A pH probe measures the pH changes during a titration experiment. In the experiment, $0.100 \text{ mol dm}^{-3}$ of an unknown monobasic acid, **HX**, was added gradually to 25.0 cm^3 of dilute sodium hydroxide of unknown concentration. The graph shows the results of the experiment.



Which statement about the results obtained from the experiment is incorrect?

- A** 0.02 mol of **HX** completely neutralises 25.0 cm^3 of dilute sodium hydroxide at the end-point.
B **HX** is a strong acid.
C The concentration of dilute sodium hydroxide used is 0.08 mol dm^{-3} .
D The pH at the end-point is pH 7.

- 16** Six oxides are listed.



What is the maximum number of oxides that can react with sodium hydroxide?

- A** 2 **B** 3 **C** 4 **D** 5

- 17** Which of the following are the common uses of sulfur dioxide?

- 1 The manufacture of bleaching agents.
- 2 The manufacture of food preservative.
- 3 The manufacture of low energy light bulbs.

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

- 18** Which of the following steps would be most suitable in preparing a high yield of pure lead(II) chloride from lead metal?

- A** Add lead to excess dilute hydrochloric acid.
B Add lead to excess dilute nitric acid. Then add dilute hydrochloric acid and filter.
C Add excess lead to dilute nitric acid. Then add dilute hydrochloric acid and filter.
D Add excess lead to dilute sulfuric acid and filter. Then add aqueous sodium chloride to the filtrate and filter.

- 19** Some statements about acids are given.

- 1 A 1 mol dm^{-3} solution of a strong acid will have a lower pH than a 1 mol dm^{-3} solution of a weak acid.
- 2 pH gives a measure of the H^+ concentration in a solution.
- 3 Universal Indicator turns red when placed in a solution of pH 5.
- 4 When an acid reacts with metals, the metal loses electrons.

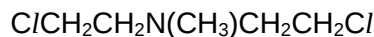
Which statements about acids are correct?

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

- 20** For the same volume and concentration, which solution contains the greatest number of ions?

- A** aqueous ammonium sulfate
B aqueous aluminium nitrate
C aqueous iron(II) nitrate
D aqueous sodium chloride

- 21** Nitrogen mustard gas has a relative molecular mass of 156.0.
The structural formula of nitrogen mustard gas is shown.



Information on the relative atomic masses of the elements are provided in the table below.

Element	Relative atomic mass
H	1.0
C	12.0
N	14.0
Cl	35.5

Which element in nitrogen mustard gas is present in the highest percentage by mass?

- A** carbon
B chlorine
C hydrogen
D nitrogen
- 22** High concentrations of ozone, O_3 , in the atmosphere at sea-level are dangerous. A maximum acceptable concentration of O_3 is $8 \times 10^{-9} \text{ g cm}^{-3}$.

How many molecules of ozone would be present in 1 cm^3 of air at this concentration of O_3 ?
 [L = the Avogadro constant]

- A** $8 \times 10^{-9} \times L \times 48$
B $\frac{8 \times 10^{-9}}{L \times 48}$
C $\frac{8 \times 10^{-9} \times 48}{L}$
D $\frac{8 \times 10^{-9} \times L}{48}$
- 23** Bacteria in the stomach of a cow produce a total volume of 480 dm^3 of gas per day under room temperature and pressure. The gases were produced as a result of fermentation of ingested glucose, $\text{C}_6\text{H}_{12}\text{O}_6$.

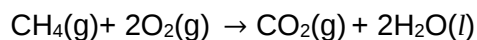
The equation for the fermentation reaction is shown.



How many moles of methane are produced per day?

- A** 10 mol
B 20 mol
C 80 mol
D 240 mol

- 24** Methane gas undergoes combustion to produce carbon dioxide gas and water.



In an experiment, 50 cm³ of methane was burned in 150 cm³ of oxygen gas in an enclosed reaction vessel.

The reaction vessel was then cooled and all volumes are measured at room temperature and pressure.

Which statements about the experiment are correct?

- 1 There is no change in mass of the reaction mixture in the vessel at the end of the experiment.
- 2 The resultant gas mixture occupies a volume of 100 cm³.
- 3 The resultant gaseous volume decreased by 50 cm³ when passed through excess aqueous potassium hydroxide.

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

- 25** A gas, **G**, has the following properties:

- 1 a choking smell
- 2 turns damp blue litmus paper red
- 3 decolourises acidified potassium manganate(VII)

What is **G**?

- A** sulfur dioxide
B carbon dioxide
C oxygen
D ammonia

- 26** A salt **H**, dissolved in water to give a green solution.

In one sample of the solution, addition of aqueous ammonia produces a green precipitate. On standing, the green precipitate turned reddish brown.

In another sample of the solution, addition of dilute nitric acid, followed by aqueous silver nitrate produces a yellow precipitate.

What is the formula of **H**?

- A** FeI₂
B FeI₃
C FeCl₂
D FeCl₃

27 Which statements describe the changes in the elements from left to right across a period of the Periodic Table?

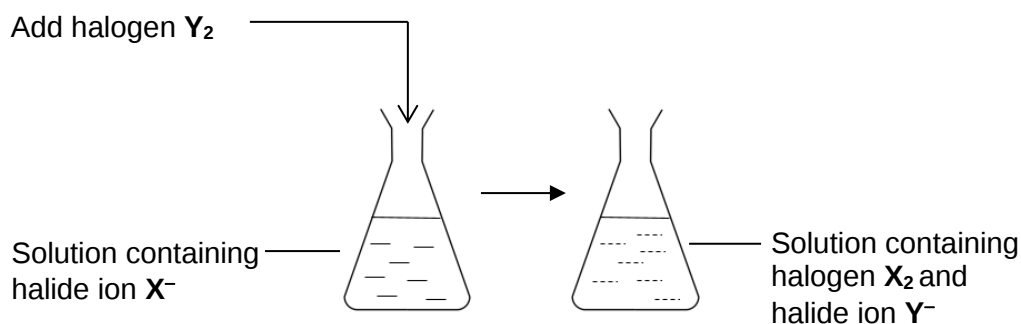
- 1 The elements change from metals to non-metals.
- 2 The number of electrons increases.
- 3 The atomic radii increases.

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

28 Which statements about halogens is correct?

- A** They form covalent bonds with the alkali metals.
- B** They react with water to form bases.
- C** Their colour darkens down the group.
- D** Their melting points decreases down the group.

29 The diagram shows an experiment involving halogens and aqueous halide ions.



Which row correctly shows the combination of Y_2 and X^- and its corresponding results?

	$At_2 + Br^-$	$Cl_2 + I^-$	$F_2 + Cl^-$
A	x	✓	✓
B	✓	x	x
C	✓	✓	✓
D	x	x	✓

key

✓ = give result shown

x = does not give result shown

- 30** Elements **P**, **Q** and **R** have increasing proton numbers but are not necessarily next to each other in the Periodic Table.

Element **Q** is chemically inert.

Element **P** dissolves readily in water. The resultant solution turns Universal Indicator purple.

Which of the following statements are correct?

- 1 **P** is a metal.
- 2 **Q** has the highest melting point.
- 3 **R** is in a different period from **P** and **Q**.

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

End of paper

The Periodic Table of Elements

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

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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