Preliminary Examination 2019
Secondary Four Express
Chemistry
Paper 1 (6092/1)

Date of Examination: 4 September 2019 **Duration: 1 hour**

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Name : _____( ) Class : _____

Instructions to Candidates

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, index number and class on the answer sheet provided.

There are **forty** 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 Optical Answer Sheet **(OAS)**.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on this paper.
A copy of the Periodic Table is printed on page **20**.
The use of an approved scientific calculator is expected, where appropriate.

Paper	Marks
1	40

Set by: Mdm Asmahan Aman

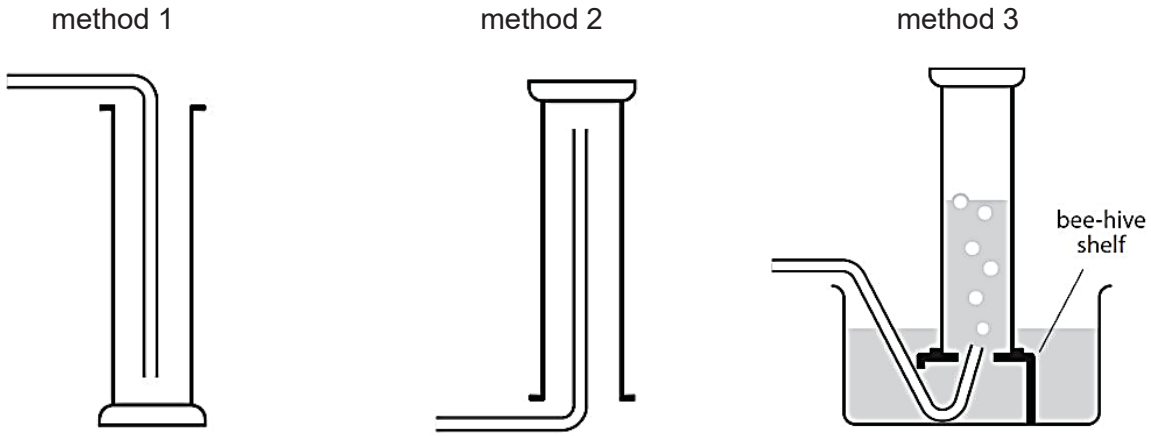
Vetted by: Mr Benjamin Pooi, Mdm Fiona Tay and Mrs Shaima Anshad

This Paper consists of **20** printed pages, including the cover page.

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1 Magnesium carbonate was reacted with excess dilute hydrochloric acid.

The diagram below shows the methods to collect gaseous products.



Which method(s) can be used to collect the gas evolved from the reaction?

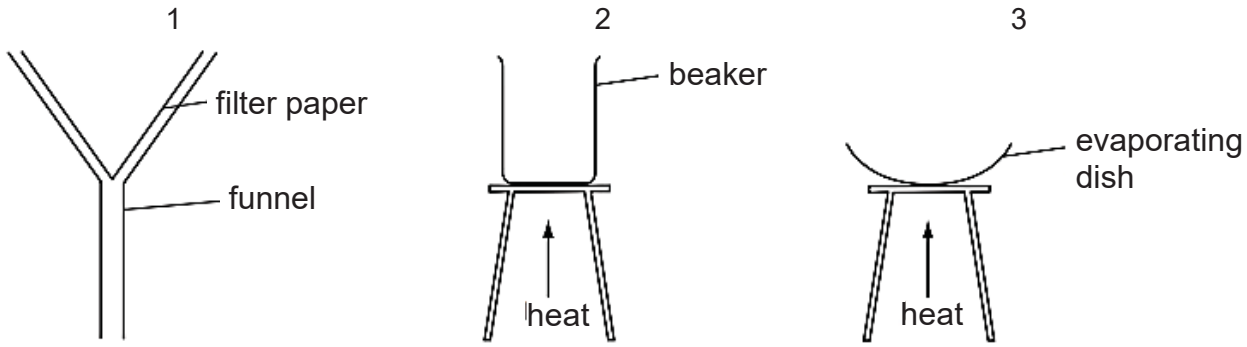
A 1 only

B 2 only

C 1 and 3

D 2 and 3

2 The diagram shows three sets of apparatus.



Which apparatus could be used to separate a mixture of copper(II) chloride and copper(II) oxide and obtain a pure sample of each solid?

A 1 only

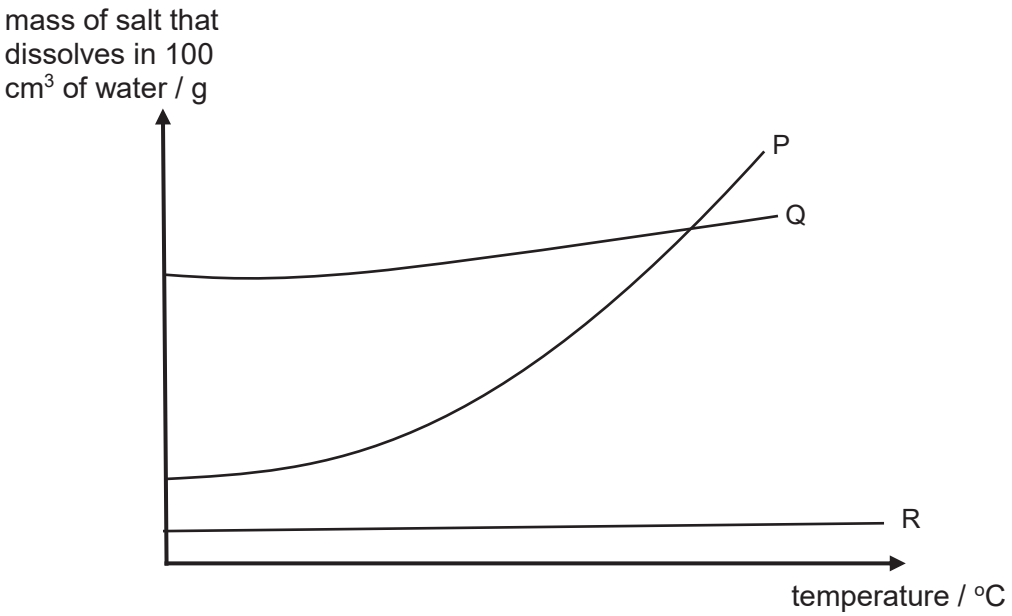
B 1 and 3

C 2 and 3

D 3 only

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3 The diagram below shows the solubility curves of 3 salts, P, Q and R over a range of temperatures. P, Q and R are added to separate beakers of water.



Which of the following shows the best method of obtaining a solid sample from the mixture?

	salt P	salt Q	salt R
A	crystallisation	filtration	evaporate to dryness
B	evaporate to dryness	evaporate to dryness	filtration
C	evaporate to dryness	crystallisation	evaporate to dryness
D	crystallisation	evaporate to dryness	filtration

4 The following reactions are carried out on solid T.

solid T + heat → brown liquid X

solid T + O_2 → colourless gases evolved

solid T + water → colourless solution Y

Which conclusion is correct?

A solution Y is a mixture

B brown liquid X is a compound

C solid T is a mixture

D solid T is a compound

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5 The gases making up dry air can be separated by fractional distillation of liquid air.

The boiling points of five of the gases in dry air are given below.

gas	boiling point / °C
N_2	– 210
O_2	– 220
Ar	– 186
Ne	– 246
Kr	– 152

In the fractional distillation of liquid air, which gas will distil off first and which gas will distil off last?

	first	last
A	N_2	O_2
B	O_2	Ne
C	Ar	N_2
D	Ne	Kr

6 Z has the atomic number 8 and mass number 18.

What are the particles present in a Z^{2-} ion?

	electrons	neutrons
A	8	8
B	8	10
C	10	18
D	10	10

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7 When sucrose is heated, it melts at 192 °C. At this temperature it starts to decompose, and the liquid sucrose turns dark brown.

Which conclusion is correct?

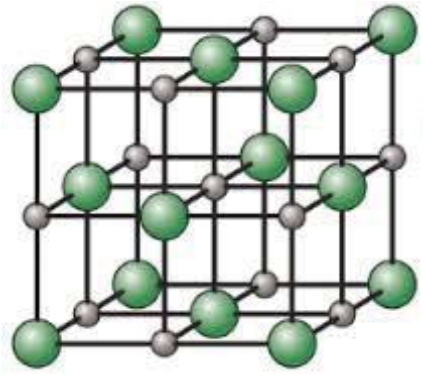
A the covalent bonds are stronger than the intermolecular forces

B the intermolecular forces, and some covalent bonds, are about the same strength

C the intermolecular forces are stronger than the covalent bonds

D the structure of the solid is a lattice structure

8 The diagram shows the arrangement of the ions in an ionic crystal.



Which compound **cannot** have this arrangement of its ions?

A lithium nitrate

B zinc sulfate

C sodium oxide

D lead(II) sulfate

9 Nitrogen forms compounds with the elements fluorine, oxygen, calcium and sodium. These compounds have the formulae NQ_2, X_3N, Y_3N_2 and NZ_3, where N represents nitrogen.

What are the identities of Q, X, Y and Z?

	F	O	Ca	Na
A	Q	X	Y	Z
B	X	Y	Z	Q
C	Y	Z	X	Q
D	Z	Q	Y	X

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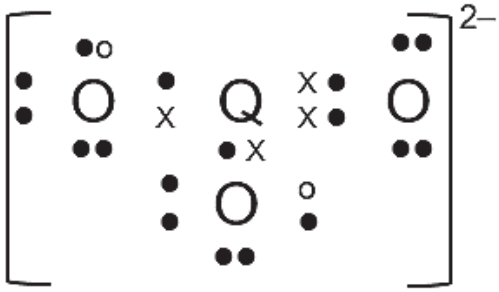
10 The diagram below shows the valence electrons of elements X and Y.



Which of the following correctly shows the type of bonds and chemical formula of the compound formed between X and Y?

	type of bonds	chemical formula
A	covalent	XY_2
B	ionic	XY
C	ionic	X_2Y_3
D	covalent	X_3Y_2

11 The ion QO_3^{2-} can be represented by the dot-and-cross diagram shown.



Which Group in the Periodic Table does Q belong to?

A I

B III

C IV

D VI

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12 Which statement about the substance formed when a given mass of an element burns in excess oxygen is **always** correct?

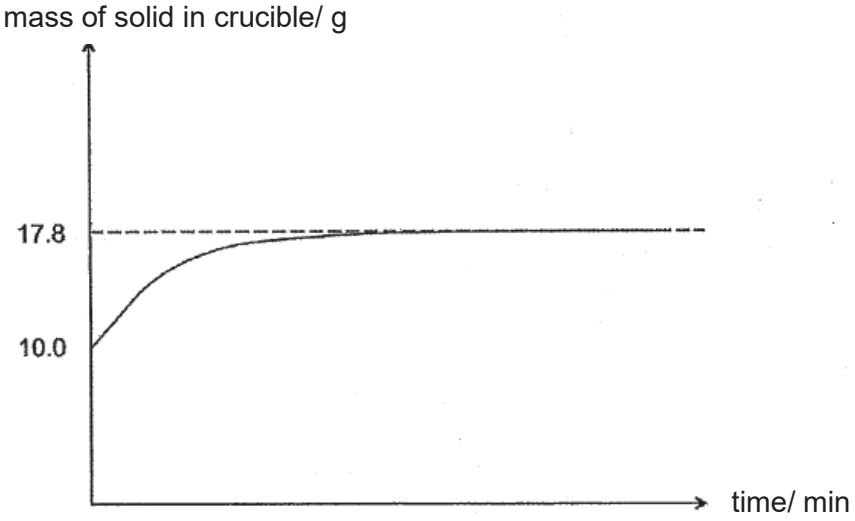
A denser than the element

B greater mass than the element

C soluble in water

D white in colour

13 10.0 g of vanadium was placed in a crucible and heated strongly in excess oxygen to produce an oxide of vanadium of unknown chemical formula. The mass of the sample in the crucible was recorded over time as shown in the graph below.



What is the formula of the oxide obtained?

A VO

B VO_2

C V_2O_3

D V_2O_5

14 A solution contains a mixture of 0.2 mol of sodium chloride and 0.2 mol of another metal chloride. The solution contains 0.6 mol of chloride ions.

Which of the following is the other metal chloride?

A potassium chloride

B magnesium chloride

C aluminium chloride

D lead(IV) chloride

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15 The gaseous hydride of a certain element X has a chemical formula XH_4. At room temperature and pressure, 7.2 dm^3 of this hydride has a mass of 9.6 g.

What is the relative atomic mass of element X?

A 12

B 24

C 28

D 32

16 In which pair does neither of the gases change the colour of damp blue litmus paper?

A ammonia and chlorine

B ammonia and hydrogen chloride

C carbon monoxide and hydrogen

D carbon dioxide and sulfur dioxide

17 An unlabelled bottle is known to contain either aqueous sodium chloride or aqueous ammonium carbonate.

How should the solution be tested in order to determine which compound is present?

A by adding aqueous barium nitrate

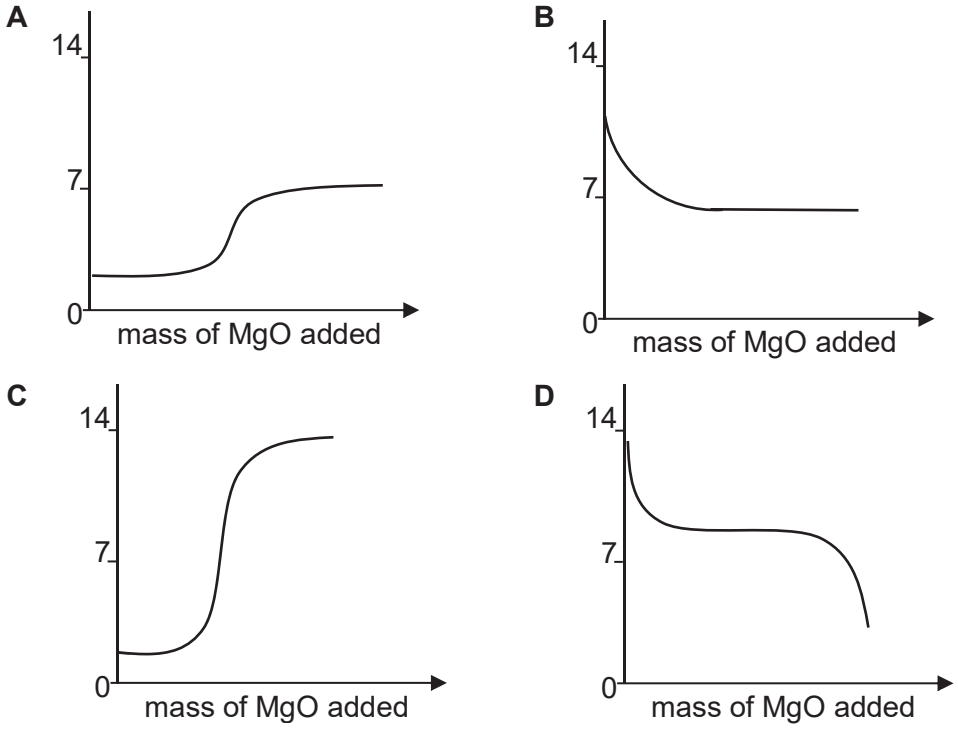
B by adding aqueous silver nitrate

C by adding aqueous potassium manganate(VII)

D by adding aqueous ammonia

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18 Which graph shows the changes in pH as an excess magnesium oxide, MgO is added to hydrochloric acid?



19 Which pair of substances would **not** be suitable for producing a large quantity of carbon dioxide?

A iron(II) carbonate and hydrochloric acid

B lead(II) carbonate and hydrochloric acid

C sodium carbonate and sulfuric acid

D calcium carbonate and nitric acid

20 Propanoic acid, ethanoic acid, hydrochloric acid and sulfuric acid each dissociate in solution.

If Universal Indicator is placed in 0.1 mol/dm^3 of each solution, which solution will produce a colour indicating the lowest pH?

A sulfuric acid

B ethanoic acid

C hydrochloric acid

D propanoic acid

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21 An atmospheric pollutant can be removed by the process of oxidation.

Which pollutant is removed by this process?

A carbon monoxide in a catalytic converter

B nitrogen dioxide in acid rain by reaction with calcium carbonate

C nitrogen dioxide in a catalytic converter

D sulfur dioxide from the flue gases by reaction with calcium carbonate

22 A student investigated the effect of heat on copper(II) nitrate crystals in a test-tube. She observed that a brown gas P was given off, and a black solid Q remained in the test-tube. The black solid was hard to clean off the glass. She added solution S to dissolve the solid.

Which of the following correctly identifies substances P, Q and S?

	brown gas P	black solid Q	solution S
A	nitrogen	copper	sodium hydroxide
B	nitrogen	copper(II) oxide	hydrochloric acid
C	nitrogen dioxide	copper	sodium hydroxide
D	nitrogen dioxide	copper(II) oxide	hydrochloric acid

23 Four elements identified only as W, X, Y and Z are all found in the third period of the Periodic Table.

1 The atomic size of Z is less than X.
2 The energy required to remove the first electron from atom Y is greater than that from the atom of Z.
3 W forms an ion which has a larger size than an atom of W.
4 X, Y and Z form ions which are smaller than their parent atoms.

Using the information, what is the most likely order of arrangement of these elements from left to right in the third period?

A X, Z, Y, W

B X, Y, Z, W

C Z, Y, W, X

D W, Y, Z, X

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24 Three types of steel have different properties.

steel 1 is easily shaped

steel 2 is brittle

steel 3 is resistant to corrosion

What are the names of these three types of steel?

	steel 1	steel 2	steel 3
A	high carbon	mild	stainless
B	high carbon	stainless	mild
C	mild	high carbon	stainless
D	mild	stainless	high carbon

25 The following shows some of the results when metals W, X and Y were added to cold water, steam and hydrochloric acid separately.

1. Only metal X does not react with cold water.
2. Metal W reacts with steam.
3. Metals W and Y react with hydrochloric acid.

Which conclusion is **not** correct?

A W is more reactive than X.

B X reacts with steam.

C Y is more reactive than X.

D Y reacts with steam.

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26 Three stages in making steel from iron ore are listed.

1 carbon dioxide reacts with carbon

2 metal oxides and oxygen are added

3 haematite is reduced

In which order do these stages occur?

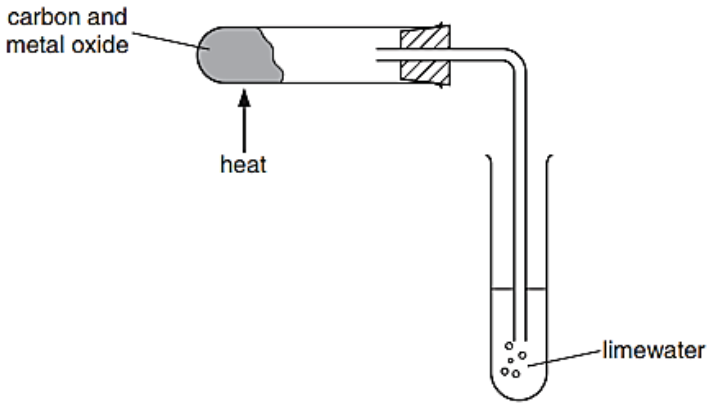
A 1 → 2 → 3

B 1 → 3 → 2

C 2 → 1 → 3

D 3 → 2 → 1

27 A metal oxide is mixed with carbon and heated as shown.



The limewater turns cloudy.

Which of the following **cannot** be the metal oxide?

A zinc oxide

B magnesium oxide

C copper(II) oxide

D iron(III) oxide

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28 Limestone can be changed into slake lime in two chemical reactions.

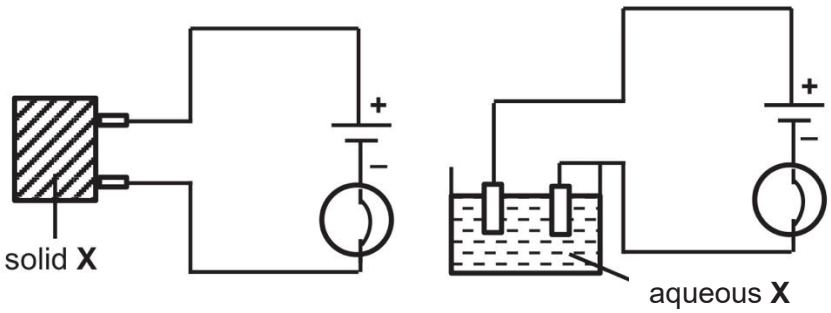
1 When limestone is heated it decomposes into lime, CaO.

2 Water is slowly dripped onto the cooled lime. The lime appears to expand and steam is produced. Slaked lime, $Ca(OH)_2$, is formed.

Which row shows the correct description of each of the chemical reactions?

	reaction 1	reaction 2
A	endothermic	endothermic
B	endothermic	exothermic
C	exothermic	endothermic
D	exothermic	exothermic

29 Two circuits are shown below. The light bulb lights up in only one of the circuits.



What is the identity of X?

A lead(II) chloride

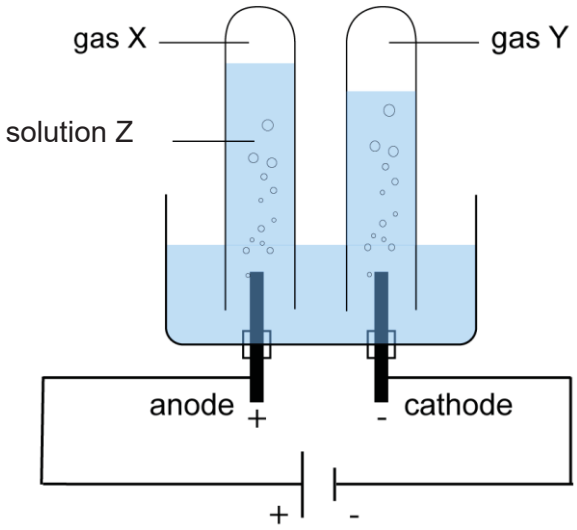
B sugar

C poly(ethene)

D sodium oxide

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30 The diagram below is a typical electrolysis set-up that collects gaseous products.

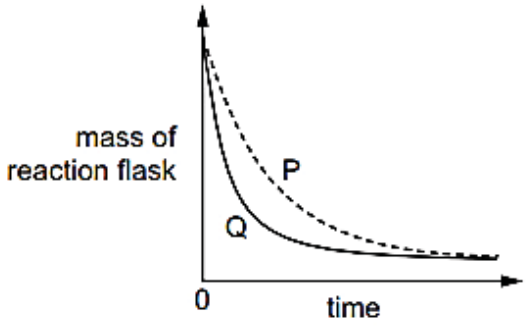


Which of the following correctly shows the identities of solution Z, gas X and Y?

	solution Z	gas X	gas Y
A	hydrochloric acid	chlorine	hydrogen
B	sodium sulfate	hydrogen	oxygen
C	sulfuric acid	oxygen	hydrogen
D	concentrated sodium chloride	chlorine	hydrogen

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31 A student investigates the rate of reaction between marble chips and hydrochloric acid.
The mass of the reaction flask is measured.
The graph shows the results of two experiments, P and Q.



Which change explains the difference between P and Q?

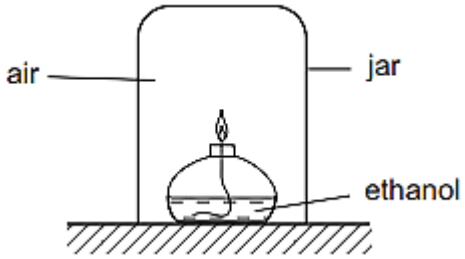
A A catalyst is added in P.

B A higher temperature is used in P.

C Bigger marble chips are used in Q.

D Hydrochloric acid is more concentrated in Q.

32 The diagram shows ethanol burning inside a sealed jar.



The mass of one gas in the jar does not change.

Which gas is this?

A carbon dioxide

B nitrogen

C oxygen

D water vapour

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33 Which one of the following conversion is an industrial process catalysed by nickel?

A ethene and hydrogen into ethane

B nitrogen monoxide into nitrogen

C nitrogen and hydrogen into ammonia

D hydrogen and chlorine into hydrogen chloride

34 Which of the following could **not** be produced when methane reacts with chlorine in the presence of ultraviolet light?

A hydrogen chloride

B tetrachloromethane

C chloromethane

D hydrogen

35 The structures of two isomers of butane, C_4H_8, are given below.

$CH_3CH_2CH=CH_2$ and $CH_3CH=CHCH_3$

How many of the statements about these two isomers are correct?

- Both will react with 1 mole of bromine to produce the same mass of products.
- Both produce the same molecule when reacted with steam.
- Both produce the same molecule when reacted with hydrogen.
- Combustion of 10 g of each isomer will produce the same volume of gas.

A 1

B 2

C 3

D 4

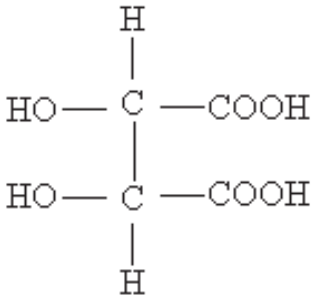
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36 Compound P reacts with compound Q to form product R.

Which of the following correctly identifies P, Q and R?

	P	Q	product R
A	CH_3OH	CO_2H	$HCO_2C_2H_5$
B	CH_3CO_2H	Na	CH_3CO_2Na
C	C_3H_7OH	$KMnO_4$	C_3H_7COOH
D	CH_3CO_2H	CH_3OH	$CH_3CO_2CH_3$

37 The diagram below shows the structural formula of tartaric acid.



Which of the following salt(s) could be formed upon reacting tartaric acid with potassium hydroxide?

1 $C_4H_5O_6K$

2 $C_4H_4O_6K_2$

3 $C_4H_3O_6K_3$

4 $C_4H_2O_6K_4$

A 2 only

B 1 and 2

C 2 and 3

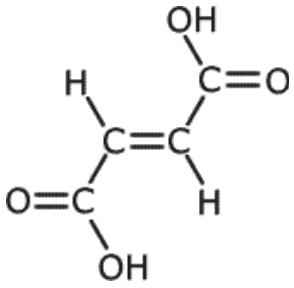
D 1, 2, 3 and 4

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38 The diagrams show four monomers.



How many of these monomers would react with the molecule below to form a polymer?



A 1

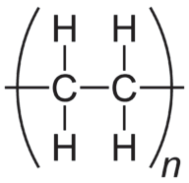
B 2

C 3

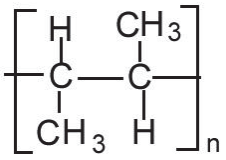
D 4

39 Which polymer does **not** have an empirical formula CH_2?

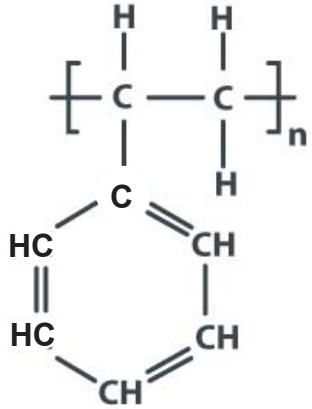
A



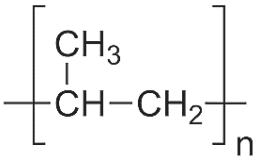
B



C



D

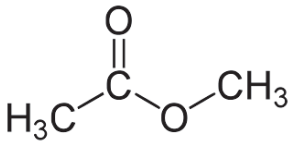


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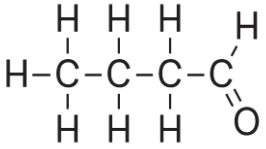
40 Ester methyl propanoate has the molecular formula $C_4H_8O_2$.

Which compound is an isomer of methyl propanoate?

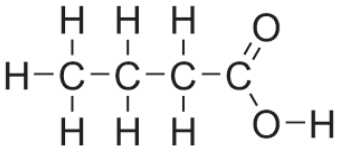
A



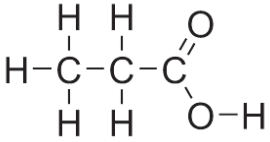
B



C



D



END OF PAPER 1

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	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 –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	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 –

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

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Preliminary Examination 2019
Secondary Four Express
Chemistry
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Date of Examination: 2 September 2019 **Duration: 1 hour 45 minutes**

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Name : _____( ) Class : _____

Instructions to Candidates

Write your name, index number and class in the spaces provided on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions in the spaces provided.

Section B
Answer all **three** questions, the last question is in the form either/or.
Answer **all** questions in the spaces provided.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the Periodic Table is printed on page 18.

The use of an approved scientific calculator is expected, where appropriate.

Section	Marks
A	50
B	30
Total	80

Set by: Mdm Asmahan, Ms Lim CF and Mdm Yasmeen

Vetted by: Mr Benjamin Pooi, Mdm Fiona Tay and Mrs Shaima Anshad

This Paper consists of **18** printed pages, including the cover page.

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Section A

Answer **all** questions in this section in the spaces provided.
The total mark for this section is 50.

A1 **(a)** Use the following list of substances to answer the questions.

iodine

magnesium

chlorine

sodium chloride

graphite

(i) Which substance conducts electricity when molten but not in solid?

…… [1]

(ii) Which substance is a solid which sublimes at a low temperature?

…… [1]

(iii) Which **two** substances conduct electricity when in a solid form?

…… [1]

(iv) Which substance is a diatomic gas?

…….. [1]

(v) Which substance reacts with acidified silver nitrate to give a white precipitate?

…… [1]

(b) Manganese is a typical transition metal element.
State **three** properties that its oxides will have.

……...

……...

……... [2]

[Total: 7]

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A2 Explain why

(a) carelessly discarding plastics can result in **long-term** pollution,

……

…… [1]

(b) not recycling metals can cause problems for **future** generations,

……

…… [1]

(c) the **incomplete** combustion of carbon-containing fuels can be dangerous to people,

……

…… [1]

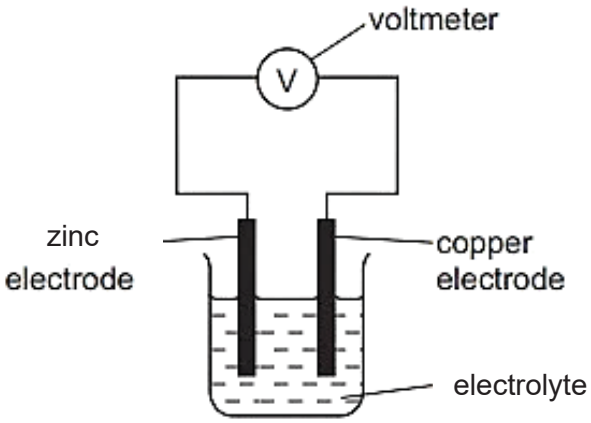
(d) the **combustion** of fossil fuels can eventually damage buildings.

……

…… [1]

[Total: 4]

A3 The diagram shows a simple cell set up.



The table shows information about zinc–copper simple cells.

Complete the table by filling in the missing information.

electrolyte	electrodes used	product of reaction at positive electrode	product of reaction at negative electrode
dilute hydrochloric acid	copper and zinc		
	copper and zinc	copper	

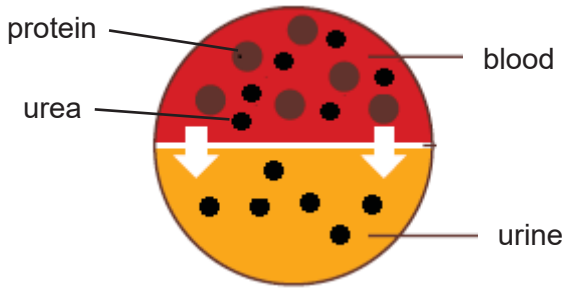
[3]

[Total: 3]

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A4 Glomerular Filtration Rate (GFR) is a test to check how well the kidneys are working. It estimates the rate at which blood passes through the kidney and urea is removed. In a healthy individual with a fully functioning kidney, the average rate of GFR is 120 ml/min.

The diagram below shows the movement of particles from blood to urine in the kidney.



(a) How does the kidney remove urea from the blood?

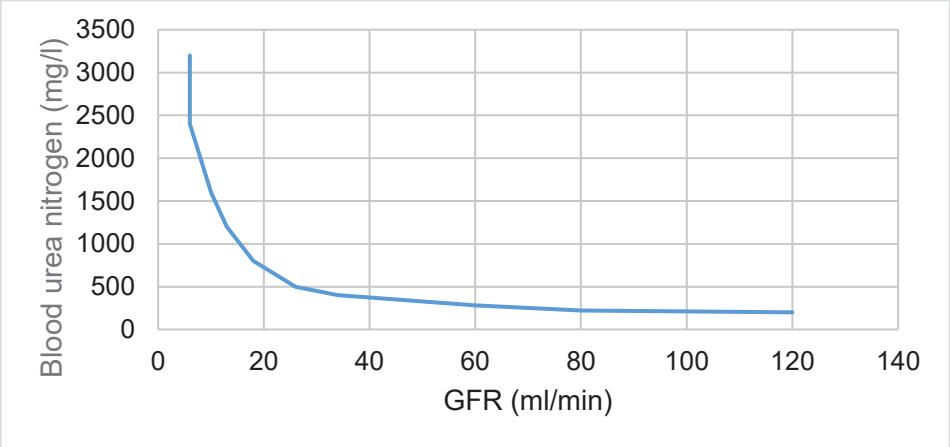
……

…… [2]

(b) Blood sample of elderly patients tend to contain traces of protein. Suggest a reason.

…… [1]

(c) The following graph shows the relationship between blood urea nitrogen levels and GFR.



(i) With reference to the graph above, state how the glomerular filtration rate (GFR) affects the blood urea nitrogen levels.

……

……

……

…… [2]

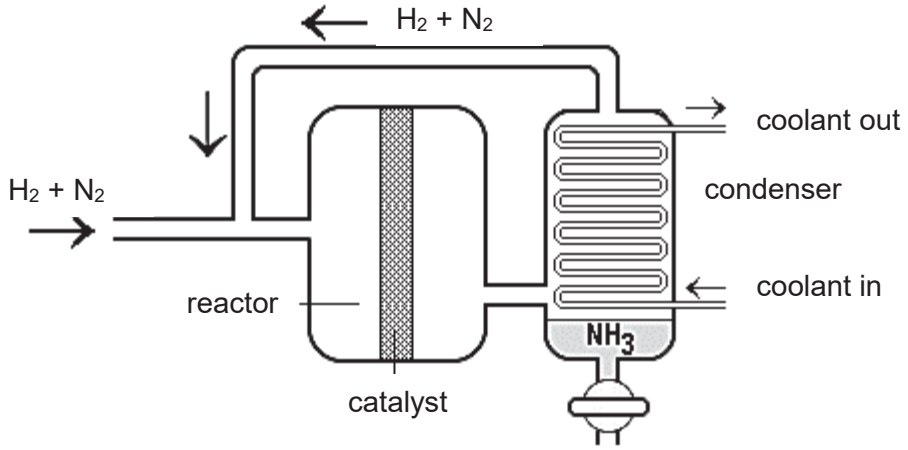
(ii) Deduce, from the graph, the normal blood urea levels in a healthy individual.

…… [1]

[Total: 6]

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A5 The diagram shows some information about the Haber process for making ammonia.



(a) Write a balanced chemical equation for the process.

……..……..……... [1]

(b) Name the catalyst used.

……..……..…… [1]

(c) When the mixture of hydrogen, nitrogen and ammonia enters the condenser, the ammonia turns to a liquid but the other gases do not.

What does this tell you about the boiling point of ammonia?

……..……..…… [1]

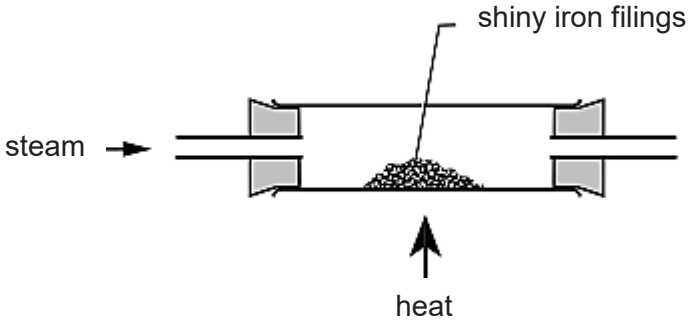
(d) Give an advantage, other than cost, of recycling unreacted nitrogen and hydrogen.

……..……..……... [1]

[Total: 4]

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A6 The diagram below shows an experiment in which steam is passed over hot iron filings. The iron filings glow, turns black and then forms a red brown iron oxide solid and a gas which burns with a blue flame.



(a) Describe how the observations would be different if the experiment was repeated using each of the following two metals in place of the iron filings.

(i) magnesium

……

…… [2]

(ii) copper

…… [1]

(b) Iron is manufactured from haematite, an oxide of iron.

Describe the manufacture of iron from haematite.

……

……

……

……

…… [3]

[Total: 6]

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A7 **P** is a mixture of iron(II) sulfate and ammonium sulfate.

The tests on **P** and some of the observations are recorded in the following table.

Complete the table by filling in the missing information.

	tests		observations
(a)	Appearance of solution **P**.		…… …… [1]
(b)	Aqueous barium nitrate was added to a portion of solution **P** followed by dilute nitric acid.		…… …… [2]
(c)	**(i)**	Excess aqueous sodium hydroxide was added to a portion of solution **P**.	…… …… [2]
	(ii)	The mixture from **(c)(i)** was filtered and the filtrate heated. The gas given off was tested with damp litmus paper.	…… …… [1]

(d) When equal volumes of potassium manganate(VII) solution and solution **P** are mixed, potassium manganate(VII) decolourises.

(i) State another observation when both solutions are mixed.

……

…… [1]

(ii) Explain, in terms of electron transfer, your answer in **(d)(i)**.

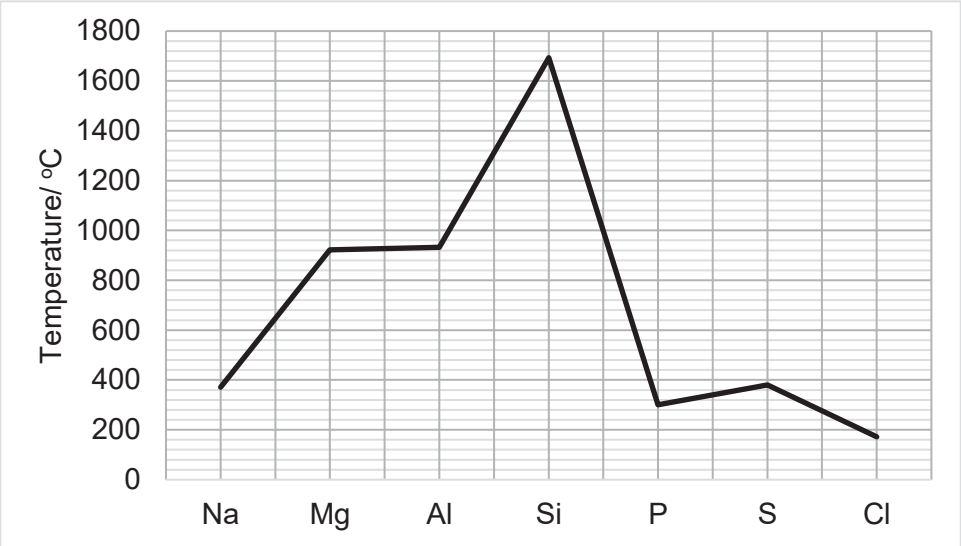
……

…… [1]

[Total: 8]

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A8 The following graph shows the melting points of elements in Period 3 of the Periodic Table.



(a) Describe the general trend in the melting points of the elements in Period 3.

……

……

…… [2]

(b) Explain the reasons, in terms of bonding, for the trend in the melting points of the elements.

……

……

……

……

……

……

……

…… [4]

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(c) Chlorine forms various oxides. The formulas and boiling points of two such oxides are given below.

name	formula	boiling point / °C
dichlorine monoxide	Cl_2O	2
dichlorine hexoxide	Cl_2O_6	200

(i) Draw a 'dot-and-cross' diagram for dichlorine monoxide.

[2]

(ii) Suggest a reason for the difference in the boiling points of the two compounds.

……..……..

……..……..

…….. [2]

(d) Predict and explain the difference in electrical conductivities of molten magnesium oxide and liquid dichlorine monoxide, in terms of structure and bonding.

……..……

……..……

……..……

……..……... [2]

[Total: 12]

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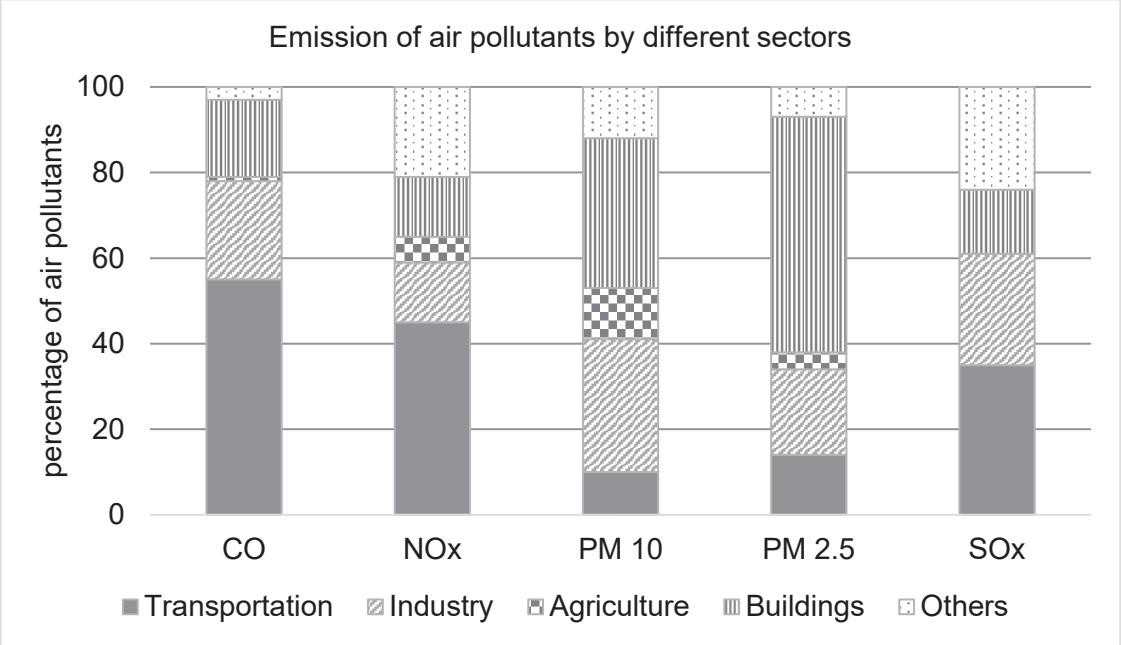
Section B

Answer all **three** questions in this section.
The last question is in the form of an either/or and only one of the alternatives should be attempted.

B9 Country **X** has been addressing the emission of air pollutants from various sectors. They have placed many regulations in place to enhance air quality. In many cases, these changes have led to a general decline in the total emissions of air pollutants. Over recent years, there has also been a modernisation of road vehicles, including the introduction of more vehicles with improved emission control.

Though many efforts have been put in place, natural causes of air pollution are still prevalent. Additionally, global shipping has been identified as one of the growing sector that releases high volumes of air pollutants. There has also been an increase in the awareness of the contribution made by national and international shipping traffic to SO_x emissions and NO_x emissions.

The stacked chart below shows the emission of air pollutants by various sectors in country **X**.



(a) Referring to the information and chart above, suggest the main source of air pollution in Country **X**. Give reason for your choice.

……

……

…… [2]

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(b) A student made the following comment after studying the chart.

"The chart shows that transportation vehicles produce a greater volume of carbon dioxide than oxides of nitrogen. Carbon monoxide, which is colourless, dissolves in rainwater to form acid rain."

Identify **two** mistakes in the student's comments. Explain why.

……

……

……..……..…….. [2]

(c) State a method used to convert carbon monoxide and nitrogen monoxide into less harmful substances in vehicles. Write a chemical equation to show the reaction.

……

……

……..……..…….. [2]

(d) Apart from the solutions suggested in **(c)**, describe **two** methods to reduce the emission of air pollutants.

……

……

……..……..…….. [2]

(e) PM10 refers to particulate matter which is 10 micrometre and smaller in size – about one-seventh the diameter of a strand of human hair. This is also found in high percentage in haze brought about by forest fires.

Suggest a possible chemical that is classified as PM10. Explain why this chemical is present in the haze.

……

……

……..……..…….. [2]

[Total: 10]

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B10 A student carried out an experiment to investigate the reaction between bromide ions and chlorine gas.

She bubbled chlorine gas through dilute aqueous potassium bromide for 6 minutes. She took samples of the reactive mixture every 30s and measured the colour intensity of each sample using a colorimeter.

A colorimeter measures the intensity of light that is absorbed by a coloured solution. The darker the colour of the solution, the more light is absorbed and the higher the reading on the colorimeter.

(a) Write an ionic equation, with state symbols, for the reaction between chlorine gas and bromide ions.

…… [2]

(b) Describe and explain how the absorbance reading change as the reaction takes place.

……

……

……

…… [3]

(c) The student carried out three more experiments to determine the time taken for each reaction to finish. She used the same volume of potassium bromide solution each time. She recorded the time taken and the absorbance reading at the end of each reaction in a table.

experiment	time taken for reaction to finish/ min	absorbance reading at the end of reaction
1	5.00	0.8
2	6.00	0.4
3	2.50	0.8
4	2.50	0.9

(i) Which experiment uses potassium bromide of a lower concentration than in experiment 1?

…… [1]

(ii) Which two experiments show the same concentration of reactants being used but at different temperatures?

…… [1]

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(d) Chlorine, bromine and iodine are elements from Group VII of the Periodic Table and they are known as halogens.

The student decided to repeat the experiment using different halide solutions.
State and explain how the absorbance reading will be higher, lower or no change compared to experiment 1.

(i) chlorine and potassium iodide

……

…… [2]

(ii) bromine and potassium chloride

……

…… [1]

[Total: 10]

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EITHER

B11 Magnesium and calcium occur naturally in the anhydrous mineral dolomite, $MgCO_3.CaCO_3$, a mixture of insoluble carbonates. Useful products such as calcium sulfate can be obtained by first adding excess hydrochloric acid to form mixture **A** and then sulfuric acid to form mixture **B**.



(a) Write one chemical equation that represents one possible chemical reaction that occurs in the scheme shown, include state symbols.

……..…….…….. [2]

(b) State the compounds present in mixture **A**.

……

……..…….…….. [2]

(c) In order to produce calcium sulfate from dolomite, it is important to add excess hydrochloric acid before sulfuric acid. Explain why.

……

……

……

……..…….…….. [2]

(d) Describe the steps to obtain dry calcium sulfate powder after the addition of sulfuric acid to mixture **A.**

……

……

……

……..…….…….. [2]

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(e) Calcium sulfate could also be produced by the following reaction.

$$Ca(NO_3)_2 + Na_2SO_4 \rightarrow CaSO_4 + NaNO_3$$

Discuss why this method is more environmentally friendly compared to the method in (d).

……

……

……

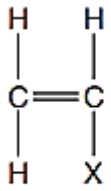
…… [2]

[Total: 10]

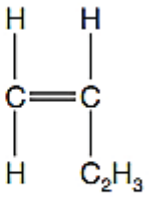
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OR

B11 Styrene-butadiene rubber is a synthetic rubber. It is made by polymerising a mixture of the monomers butadiene and styrene.



styrene



butadiene

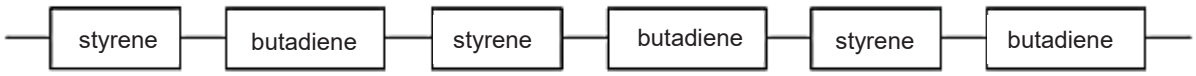
(a) What type of polymerisation will take place when the monomers polymerise? Explain your reasoning.

……

……

…… [2]

(b) One possible structure for the polymer is shown below.



(i) Give the structural formula for the repeating unit in this polymer structure.

[2]

(ii) When the mixture of styrene and butadiene polymerises, the polymer is unlikely to contain only this regular, repeating pattern. Suggest a reason.

……

…… [1]

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(c) Butadiene can be made by cracking butane in a cracking tower.

(i) Butane cracks to form butadiene and one other product.
Write an equation to show this reaction.

…… [1]

(ii) Give a use of the other product in this reaction.

…… [1]

(d) 2.90 kg of butane entered the cracking tower. After the reaction, 2.16 kg of butadiene was made.

Calculate the percentage yield of butadiene.

[3]

[Total: 10]

END OF PAPER 2

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	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 –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	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 –

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

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Secondary 4E
Chemistry
Preliminary Examination 2019

Mark Scheme

Paper 1 (40 marks)

1	C	**11**	C	**21**	A	**31**	D
2	B	**12**	B	**22**	D	**32**	B
3	D	**13**	D	**23**	A	**33**	A
4	A	**14**	B	**24**	C	**34**	D
5	D	**15**	C	**25**	B	**35**	C
6	D	**16**	C	**26**	B	**36**	D
7	B	**17**	A	**27**	B	**37**	B
8	C	**18**	A	**28**	B	**38**	C
9	D	**19**	B	**29**	D	**39**	C
10	A	**20**	A	**30**	C	**40**	C

A – 8 B – 11, C – 11, D - 10

Paper 2
Section A (50 marks)

A1(a)(i)	sodium chloride	1
(ii)	Iodine	1
(iii)	Magnesium and graphite	1
(iv)	Chlorine	1
(v)	Sodium chloride Misconception: Chlorine reacts with silver nitrate (confused QA and displacement)	1
(b)	Basic oxide, high melting point, solid Any other acceptable properties of ionic or basic compound Did not see property of oxide. Explain in terms of the metal	1m -2 correct 2m – all correct
		Total: 7
A2 (a)	Plastics are <u>non-biodegradable</u> and when <u>disposed in landfills it cause land pollution/ water pollution</u>.	1
(b)	Metals are <u>finite resources</u> and it will be <u>not available for future</u> generations if it is used up	1
(c)	<u>Carbon monoxide</u> is produced and it <u>reduces the ability of the blood to carry oxygen</u> Reasons state like headaches, breathing difficulty and fatigue.	1
(d)	<u>Sulfur dioxide</u> is produced and <u>cause acid rain</u> when dissolved in rainwater. Acid rain corrodes building Incomplete answers and students tend to think that carbon dioxide and oxides of nitrogen are formed	1
		Total: 4

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<table>
<tr><td>A3</td><td>
<table>
<tr><th>electrolyte</th><th>electrodes used</th><th>product of reaction at positive electrode</th><th>product of reaction at negative electrode</th></tr>
<tr><td>dilute hydrochloric acid</td><td>copper and zinc</td><td>hydrogen [1]</td><td>zinc ions</td></tr>
<tr><td>any copper(II) salt solution [1]</td><td>copper and zinc</td><td>copper</td><td>zinc ions</td></tr>
</table>
Very badly done</td><td>Both zinc ions correct – 1m</td></tr>
<tr><td colspan="3">Total: 3</td></tr>
<tr><td>A4(a)</td><td>Kidney uses the concept of filtration to separate smaller solids from liquid blood, using membrane /filter.
Particles smaller than the holes/pores of the filter layer passes over to the urine, while the particles bigger cannot be filtered.

Biology students answered with biology content that is not relevant.</td><td>1

1</td></tr>
<tr><td>(b)</td><td>The filter layer in elderly patients probably have enlarged hole or torn surface.</td><td>1</td></tr>
<tr><td>(c)(i)</td><td>When GFR is high (above 40 ml/min), blood urea nitrogen level in low, below 250 mg/l.
When GFR drops below 30 ml/min, blood urea nitrogen level exponentially increases to as high as 3000 mg/l./ When GFR goes from about 5 to 30 ml/min, the blood urea nitrogen drops drastically from about 3200 to 500 mg/l.

No data was used. Wrong data was used.</td><td>1

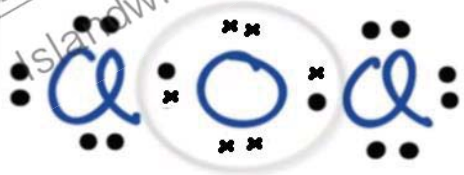
1</td></tr>
<tr><td>(ii)</td><td>200 – 250 mg/l</td><td>1</td></tr>
<tr><td colspan="3">Total: 6</td></tr>
<tr><td>A5(a)</td><td>$N_2 + 3H_2 \rightleftharpoons 2NH_3$
Wrong arrow used</td><td>1</td></tr>
<tr><td>(b)</td><td>Iron</td><td>1</td></tr>
<tr><td>(c)</td><td>Boiling point of ammonia is higher than nitrogen and hydrogen.</td><td>1</td></tr>
<tr><td>(d)</td><td>Increase yield of ammonia/ conserve hydrogen since it is produced from cracking/ electrolysis of water</td><td>1</td></tr>
<tr><td colspan="3">Total: 4</td></tr>
<tr><td>A6(a)(i)</td><td>Magnesium burns brightly/ white light
White solid magnesium oxide formed</td><td>1
1</td></tr>
<tr><td>(ii)</td><td>No visible change
A few students thought that copper will react with steam</td><td>1</td></tr>
<tr><td>(b)</td><td>Coke reacts with oxygen to form carbon dioxide.
Carbon dioxide reacts with more coke to form carbon monoxide.
Carbon monoxide reduces iron(III) oxide to form iron and carbon dioxide.
Limestone decompose to form calcium oxide.
Calcium oxide reacts with impurity sand to form slag.</td><td>1

1

1</td></tr>
</table>

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		Total: 6
A7(a)	Green	1
(b)	White precipitate. Precipitate insoluble in acid/ no visible change observed with acid	1 1
(c)(i)	Green precipitate insoluble in excess	2
(ii)	Red litmus paper turns blue	1
(d)(i)	Green solution turns yellow / reddish brown Not familiar with iron (II) oxidising to iron (III)	1
(ii)	Iron (II) ions in P lose electrons to form iron(III) ions. A number thought that ammonium sulfate is an oxidising agent	1
		Total: 8
A8(a)	Melting point of elements increase rapidly from sodium to silicon, with the exception of magnesium and aluminium with almost the same point. The melting point drops from silicon to phosphorus, and the value rises slightly from phosphorus to sulfur and drops from sulfur to chlorine. The trend was poorly described; as students were not able to use appropriate words.	1 1
(b)	Magnesium and aluminium have strong electrostatic forces of attraction between cations and delocalised electrons. Lots of energy needed to overcome the attraction. Sodium is an exception with lower melting point as it is from group I. Silicon has strong covalent bonds between atoms. Lots of energy needed to overcome the bonds. [Silicon-- giant molecular structure] Phosphorus, sulfur and chlorine has weak intermolecular forces of attraction between molecules. Little energy needed to overcome the forces of attraction. Students did poorly for this question; they confused the elements with oxides of the elements. Proper usage of keywords such as atoms/ ions/ molecules.	1 1 1 1
(c)(i)	 correct number of bonding electrons 1m correct number of electrons around atom 1m dot-and-cross diagram was well done.	Max 2
(c)(ii)	Dichlorine hexoxide is a bigger molecule than dichlorine monoxide. Hence the intermolecular forces of attraction between molecules are higher compared to dichlorine monoxide. Hence more energy needed to overcome the forces of attraction. Poorly done; students confused breaking of molecule with breaking of bonds in molecule during melting.	1 1

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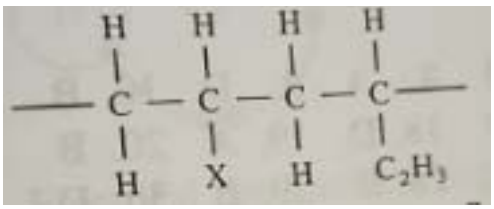
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(d)	Molten magnesium oxide <u>has free moving cations and anions</u> to <u>carry electric charges</u>. Hence able to conduct electricity. Liquid dichlorine monoxide has <u>no free moving electrons</u> to carry electric charges. Hence unable to conduct electricity. Well done by majority; some students poorly used keywords such as cations and electrons.	1 1
		Total: 12

Section B (30 marks)

A8(a)	Vehicles / ships {Transportation alone – No marks} As carbon monoxide, oxides of nitrogen and sulfur dioxide are common air pollutants, <u>transportation contributes the highest percentage of these pollutants.</u> Students predicted transportation as the main reason, but failed to suggest the exact reason.	1 1
(b)	Carbon monoxide is a <u>neutral compound</u>, Hence it <u>cannot produce acid</u> when in contact with rain water. The chart <u>shows values for carbon monoxide</u>; values of carbon dioxide cannot be predicted from the graph. The chart did not show that the vehicles produce a greater volume of carbon monoxides than oxides of nitrogen. Instead it <u>shows the percentage contribution</u> of each sector / the charts are <u>independent of each other</u> and cannot be compared. (any two) Relatively well done; but students confused percentage graph to volume graph.	1 each Max 2
(c)	<u>Catalytic converter can be fixed in cars</u> to convert carbon monoxide and nitrogen monoxide into carbon dioxide and nitrogen gas, which are less harmful. $2CO + 2NO \rightarrow N_2 + 2CO_2$ Well done; but students did not study the equation.	1 1
(d)	Sulfur emission from industries can be reduced by flue gas desulfurization. / remove sulfur from fossil fuels before they are burnt / advise clean alternate fuels for vehicles such as hydrogen or biofuels / use electric cars. (any two reasonable answers) Well done; vague answers were rejected.	2
(e)	<u>Unburnt carbon/ unburnt hydrocarbon</u> from <u>incomplete combustion</u> of trees rich in <u>carbon compounds.</u> Poorly done; students were not able to relate the reason for haze.	1 1
		Total: 10
B10(a)	Cl_2 (g) + $2Br^-$ (aq) → Br_2 (aq) + $2Cl^-$ (aq) Students wrote chemical equations, wrong or missing state symbols 1m - eqn 1m – state symbols	2

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(b)	Reading increase as reaction takes place as more bromine is formed. Chlorine displaces bromide to form bromine and hence turns darker/brown causing the reading to increase Students are not able to explain displacement correctly.	1 1 1
(c)(i)	2	1
(ii)	1 and 3	1
(d)(i)	Higher Iodine is darker than bromine. / Iodine is black.	1 1
(ii)	No change as no reaction. Students did not realise that the solution appears reddish brown so no change to the reading.	1
		Total: 10
B10(a)	$CaCO_3$ (s) + 2HCl (aq) → $CaCl_2$ (aq) + CO_2 (g) + H_2O (l) $MgCO_3$ (s) + 2HCl (aq) → $MgCl_2$ (aq) + CO_2 (g) + H_2O (l) $CaCl_2$ (aq) + H_2SO_4 (aq) → $CaSO_4$ (s) + 2HCl (aq) (any one equation)	1 for balanced eqn; 1 for state symbols
(b)	Magnesium chloride and calcium chloride	2
(c)	If sulfuric acid is added in the first step, an insoluble salt, calcium sulfate will be formed on the surface of dolomite, hence preventing further reaction. Also it would not be possible to remove calcium sulfate from the dolomite, as both the reactants as well as the products are insoluble.	1 1
(d)	Filter the mixture to obtain the precipitate as the residue. Wash the precipitate with distilled water. Dry the precipitate between sheets of filter papers.	1 1
(e)	Adding hydrochloric acid to the insoluble carbonates will produce a lot of carbon dioxide gas; while adding sodium sulfate to calcium nitrate does not produces any toxic gas. Carbon dioxide is a greenhouse gas that would contribute to global warming.	1 1
		Total: 10 marks
B11OR (a)	Addition polymerisation. Both monomers are unsaturated/ contain C=C	1 1
b(i)	 1m 1m	2
(b)(ii)	Polymerisation is random/ Styrene can add to another styrene resulting in polystyrene. Butadiene can also polymerise into polybutandiene. If styrene and butadiene were to polymerise	1

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	randomly, the chain will be irregular such as styrene – styrene - butadiene - …	
(c)(i)	$C_4H_{10} \rightarrow C_4H_6 + 2H_2$	1
(ii)	Rocket fuel / manufacture of ammonia in Haber process / fuel cell / convert alkene to alkane (hydrogenation)	1
(d)	Moles of butane = 2.9 / (12 x 4 + 10) = 0.05 Moles of butadiene = 0.05 Mass of butadiene = 0.05 x (12 x 4 + 6) = 2.7 kg % yield = 2.16/ 2.7 x 100% = 80%	1 1 1
		Total: 10

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