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</u>/ <u>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

<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 <u>concept of filtration</u> to <u>separate smaller solids</u> from liquid blood, using membrane /filter.
<u>Particles smaller than the holes/pores of the filter layer passes over to the urine</u>, while the particles bigger cannot be filtered.

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

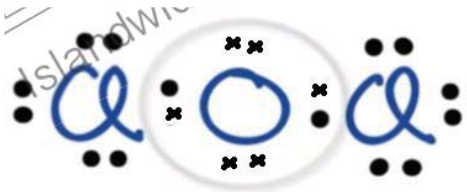
1</td></tr>
<tr><td>(b)</td><td>The filter layer in elderly patients probably have <u>enlarged hole or torn surface</u>.</td><td>1</td></tr>
<tr><td>(c)(i)</td><td>When <u>GFR is high</u> (above 40 ml/min), <u>blood urea nitrogen level in low</u>, below 250 mg/l.
When <u>GFR drops below 30 ml/min</u>, <u>blood urea nitrogen level exponentially increases</u> 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

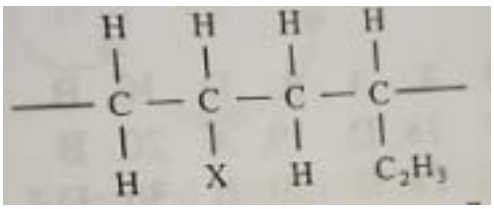
1</td></tr>
</table>

		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

(d)	Molten magnesium oxide has free moving cations and anions to carry electric charges. Hence able to conduct electricity. Liquid dichlorine monoxide has no free moving electrons 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, transportation contributes the highest percentage of these pollutants. Students predicted transportation as the main reason, but failed to suggest the exact reason.	1 1
(b)	Carbon monoxide is a neutral compound, Hence it cannot produce acid when in contact with rain water. The chart shows values for carbon monoxide; 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 shows the percentage contribution of each sector / the charts are independent of each other and cannot be compared. (any two) Relatively well done; but students confused percentage graph to volume graph.	1 each Max 2
(c)	Catalytic converter can be fixed in cars 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)	Unburnt carbon/ unburnt hydrocarbon from incomplete combustion of trees rich in carbon compounds. Poorly done; students were not able to relate the reason for haze.	1 1
		Total: 10
B10(a)	$Cl_2 (g) + 2Br^- (aq) \rightarrow Br_2 (aq) + 2Cl^- (aq)$ Students wrote chemical equations, wrong or missing state symbols 1m - eqn 1m – state symbols	2

(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

	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