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Suggested Answers to 2019 O level Chemistry 6092/ Paper 2

Section A

A1

(a) D, G
(b) A, E
(c) C
(d) G
(e) A

A2

(a) Isotopes of the same element have the same number of protons and electrons but different number of neutrons. 1, 2 and 3 have the same number of 16 protons and 16 electrons, but 1 has 13 neutrons, 2 has 14 neutrons and 3 has 15 neutrons. Thus, they are isotopes of the same element.

(b) Chemical property of an element is determined by the number of valence electrons of an element. In this case, all three isotopes have same 6 electrons in the outer shell, thus, they have the same chemical reactions.

(c) (i) X: Sulfur
Y: oxygen
Z: Zinc

(ii) Lowest melting point: oxygen
Sulfur
Highest melting point: Zinc

Zinc has a metallic structure with strong electrostatic forces of attraction between the positive zinc ions and the sea of delocalised electrons. Large amount of energy is needed to overcome the strong electrostatic forces of attraction and thus, it has the highest melting point. Oxygen and sulfur have a simple molecular structure with weak intermolecular forces between the molecules. Small amount of energy is needed to overcome the weak forces between the molecules. Thus, they have lower melting point than zinc. However, sulfur has a larger molecular mass and hence it has higher melting point than oxygen.

(iii) Zinc. Zinc is a reactive metal which reacts with acids to form salt and hydrogen. Both sulfur and oxygen are non-metals which do not react with acid.

A3

(a) Lead is above hydrogen in the reactivity series but gold is below hydrogen in the reactivity series and hence does not react with nitric acid.

(b) Compounds of lead reacts with dilute hydrochloric acid and dilute sulfuric acid to form lead chloride and lead sulfate respectively which are insoluble solids and form a layer preventing further reactions. These solids cannot be removed from gold. However, compounds of lead react with dilute nitric acid to form lead nitrate which is soluble and hence, can be easily removed from gold by filtration.

(c) (i) Both lead and aluminium ions form a white precipitate that is insoluble in excess aqueous ammonia thus aqueous ammonia cannot be used to identify them. Zinc ions form a white precipitate of zinc hydroxide in aqueous ammonia that is soluble in excess aqueous ammonia. Thus, aqueous ammonia can only be used to identify zinc ion in solution.

(ii) Add hydrochloric acid to solutions containing the other two ions. White precipitate of lead chloride will be observed in solution containing lead ions while no precipitate will be observed in solution containing aluminium ions as aluminium chloride is soluble.

(iii) Add sodium hydroxide to the solution followed by a small piece of aluminium foil and warm gently. If nitrate ions is present, a gas will be produced that turns moist red litmus paper blue. Gas is ammonia.

A4

(a) NH_3 (g) + HCl (g)→ NH_4Cl (s)

(b) (i) Mr of NH_3: 17

Mr of HCl: 36.5

(ii) The measurement obtained in the experiment does not support the conclusion. To be inversely proportional, both Mr and distance travelled must be related by a constant.

For NH_3, 17 x 60= 1020
For HCl, 36.5 x 40 = 1460
Since they are not related by a constant, rate of diffusion is not inversely proportional to the relative molecular mass of gas but only inversely related.

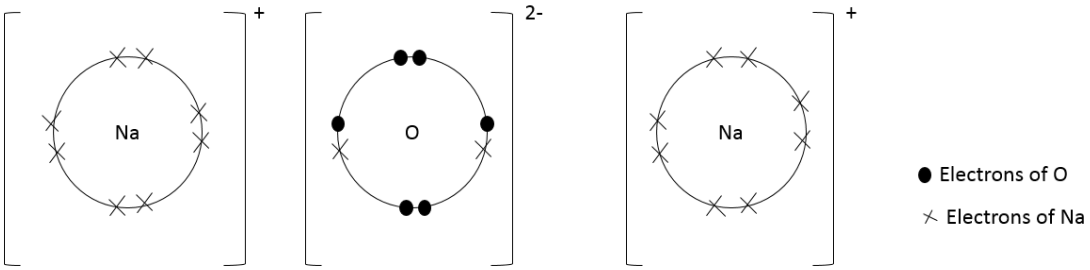
(c) Ammonium chloride solid would similarly form closer to hydrochloric acid due to the lower relative molecular mass of ammonia. However, the white ring of ammonium chloride will take a longer time to form as compared to experiment A due to the lower temperature.

A5

(a) Experiment using sodium: the solution of red litmus indicator turns blue. Sodium oxide formed is a basic oxide and dissolves in water to give sodium hydroxide which is alkaline.

Experiment using sulfur: the solution of red litmus indicator remains red. Sulfur dioxide formed is an acidic oxide and dissolves in water to give acidic solution.

(b)



(c) (i) $4Na + O_2 \rightarrow 2Na_2O$
No. of moles of Na = 0.50/23 = 0.021739 mol
No. of moles of Na_2O formed = 0.021739 /2 = 0.010869 mol
Theoretical yield of Na_2O = 0.010869 x (23 x 2 + 16) = 0.6739g
≈ 0.674g

(ii) Mass of sodium oxide collected at the end of experiment = 94.82 -94.50
= 0.32g

Percentage yield = (0.32/ 0.6739) x 100 = 47.48%
≈ 47.5 %

(iii) The sodium might be impure and contains impurities that burn in air to form gaseous product that escapes into the air. Hence, causing the mass of sodium oxide produced to be lower than expected.

A6

(a) Magnesium being more reactive than iron, acts as a sacrificial protection that rusts in place of iron.
$Mg\ (s) \rightarrow Mg^{2+}\ (aq) + 2e$

(b) (i) Oil and paint coat a layer around the steel pipe, preventing air and moisture in the air from coming into contact with iron in the steel pipe.

(ii) Since the underground pipes are surrounded by soil, the layer of oil and paint can be easily scratched, and the iron underneath would be exposed to rusting. Furthermore, these pipes are used to transport crude oil over long distances. Hence, they are long and would be difficult to coat it with paint and oil and to maintain them.

A7

(a) As the metals have different reactivity, different voltages are produced. The greater the difference in reactivity, the greater the voltage produced.

(b)

Metal 1	Metal 2	Predicted voltage /V
Copper	Iron	0.80
Silver	Magnesium	2.00

Accept other possible answers

Section B

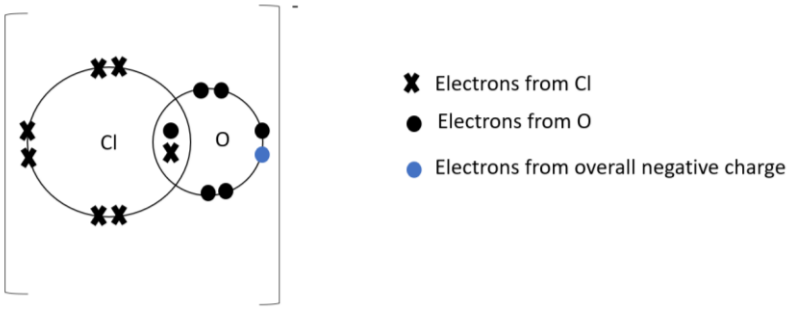
B8

(a) It is negatively charged and contains oxygen in the complex ion.

(b) (i) $NH_2Cl + NaOCl \rightarrow NHCl_2 + NaOH$
$NHCl_2 + NaOCl \rightarrow NCl_3 + NaOH$
(ii) Oxidation states of N in NH_2Cl: -1
$NHCl_2$: +1
NCl_3: +3

Sodium chlorate acts as an oxidising agent as it oxidises NH_2Cl in the first reaction. The oxidation state of N increases from -1 in NH_2Cl to +1 in $NHCl_2$. Similarly, it oxidises $NHCl_2$ in the second reaction. The oxidation state of N increases from +1 in $NHCl_2$ to +3 in NCl_3.

(c)



(d) % mass of chlorate (I) ions in $Ca(OCl)_2$ = (35.5 x 2 + 16 x 2) / (35.5 x 2 + 16 x 2 + 40) x 100
= 72. 0279%
≈ 72.0 %
% mass of chlorate(I) ions in NaOCl = (35.5 + 16) / (35.5 + 16 +23) x 100
= 69.1275%
≈ 69.1 %
Since 72.0% > 69.1%, the percentage by mass of chlorate (I) ions in calcium chlorate (I) is greater than in sodium chlorate (I).

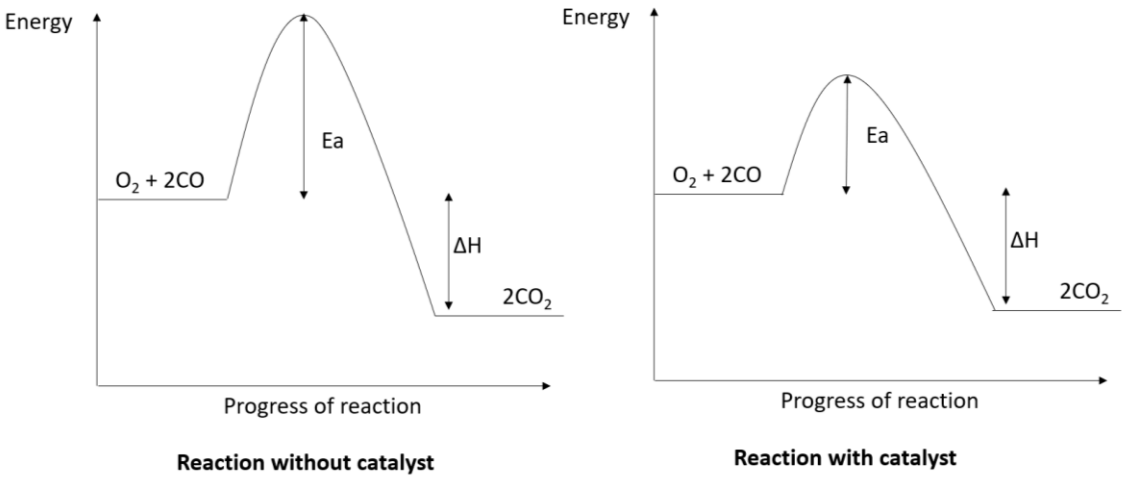
(e) CaO_2

(f) Hydrogen peroxide oxidises and breaks down compounds and produces water only which is a clean reaction. Hypochlorite bleaches contain sodium hypochlorite which oxidises substances such as human wastes to form nitrogen trichloride. Compounds of nitrogen and chorine are irritating and toxic to people and hence can cause people to have adverse reactions.

B9

(a) Stage 2: Carbon monoxide molecules are adsorbed onto the surface of the catalyst.
Stage 3: The adsorbed oxygen atoms are brought close together with the adsorbed carbon monoxide molecules and new bonds are formed on the catalyst surface. Carbon dioxide molecules are formed, which remains adsorbed on the surface.
Stage 4: The carbon dioxide molecules are released from the catalyst surface to form carbon dioxide gaseous molecules.

(b)

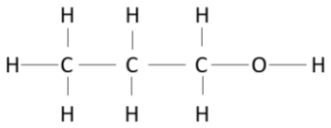
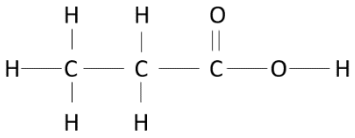


(c) A palladium catalyst provides an alternative pathway with lowered activation energy. Thus, more reacting particles would possess sufficient energy to collide and result in a reaction. Frequency of effective collision increases and hence rate of reaction increases.

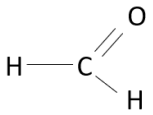
B10 EITHER

(a) Potassium manganate and potassium dichromate

(b) (i)

Name of series	**Alcohols**	**Carboxylic acids**
Name of third member	Propanol	Propanoic acid
Displayed formula of third member		

(ii)



(c) (i) $CH_3OH + CO \rightarrow CH_3COOH$

(ii) HI. HI is produced at the end of the reaction which shows that it <u>did not take part in the reaction</u>, which is a characteristic property of a catalyst.

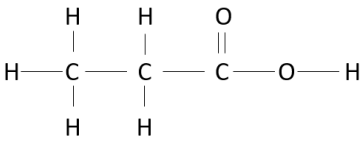
(d) (i) The yield of ethanoic acid would <u>decrease</u>. This unwanted reaction uses H_2O as a reactant and would <u>decrease the amount of H_2O available for reaction</u> in the last stage of ethanoic acid manufacturing.

(ii) H_2 could be used as a <u>raw material for the manufacturing of ammonia</u> in the Haber process.

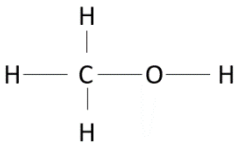
B10 OR

(a) Both isomers 1 and 2 would turn the universal indicator from green to orange as they contain the carboxyl functional group and can partially dissociates in water to give hydrogen ions. Isomer 3 would cause universal indicator to remain green as it is an ester which is neutral.

(b)



Propanoic acid



Methanol

(c) (i)

	C	**H**	**O**
% mass	62.1	10.3	27.6
Ar	12	1	16
No. of moles	5.175	10.3	1.725
Molar Ratio	3	6	1

Therefore, empirical formula of R: C_3H_6O

(ii) $(C_3H_6O)_2$

Therefore, molecular formula: $C_5H_{11}COOH$