CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the May/June 2013 series

0620 CHEMISTRY

0620/31 Paper 3 (Extended Theory), maximum raw mark 80

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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International Examinations

1 **(a)** **(i)** contains carbon and hydrogen [1]
cond: only / just [1]

(ii) (different) boiling points [1]
cond: separate [1]

(b) bitumen-making roads / roofs / water-proofing, etc. [1]

lubricating fraction – waxes / vaseline / grease, etc. or machinery example, e.g. (oil a) bike / hinges / reducing friction [1]

paraffin fraction – jet fuel / (home) heating or tractors or cooking or lighting [1]

gasoline fraction – petrol or fuel for cars / vans / trucks [1]

[Total: 8]

2 **(a)** 3 or III [1]

(b) good conductor and it is a metal/has delocalised (free) electrons [1]

(c) N **or** P **or** As **or** Sb [1]
accept Bi

(d) $\mathbf{M}_2(SO_4)_3$ [1]
accept: $Ga_2(SO_4)_3$

(e) it would react with/dissolves in a named strong acid [1]
it would react with/dissolves in a named alkali [1]
it shows both basic and acid properties =1 [1]
it reacts with both acids and bases/alkalis =1 [1]
[max 2]

[Total: 6]

3 **(a)** **(i)** pieces have (same) surface area [1]
same amount / mass / quantity / volume / number of moles of carbonate [1]

(ii) no more bubbles / carbon dioxide **or** piece disappears / dissolves [1]

(b) experiment 1 Ca^{2+} + CO_2 + H_2O [1]

(c) **(i)** more concentrated **or** higher concentration (of acid) (in experiment 1) [1]
accept: arguments based on collision theory

(ii) ethanoic acid is a weak acid **or** hydrochloric acid is a strong acid [1]
accept: stronger or weaker

ethanoic acid less ionised / dissociated / lower / smaller concentration of hydrogen ions [1]
accept: less hydrogen ions and vice versa argument but not dissociation of ions

(iii) lower temperature (particles) have less energy [1]
moving more slowly [1]
fewer collisions / lower collision rate [1]
or
lower temperature (particles) have less energy [1]
fewer particles collide [1]
with the necessary energy to react [1]
note: less energy fewer successful collisions gains all 3 marks

[Total: 10]

4 **(a)** it is an alkane **or** hydrocarbon [1]
it is saturated **or** only C—C single bonds [1]
accept: no double bonds

(b) molecular formula C_6H_{12} [1]
empirical formula CH_2 [1]

(c) correct structural formula of cyclobutane [1]

(d) (i) C_6H_{12} [1]
accept: a correct structural formula

(ii) same molecular formula **not**: chemical formula [1]
different structural formulae / structures [1]

(e) add bromine (water) or (l) [1]

cond: (remains) brown **or** orange **or** red or yellow [1]

cond: changes from brown, etc. to colourless or decolourises [1]
not: clear

OR
potassium manganate(VII) [1]
note: oxidation state not essential but if given must be correct or [0]
accept: potassium permanganate

cond: remains pink / purple [1]

cond: changes from pink to colourless **(acidic)** [1]
not: clear

cond: change from pink to green / brown **(alkaline)**

[Total: 11]

5 (a) (i) any metal above zinc
$Mg \rightarrow Mg^{2+} + 2e^-$ [1]

(ii) $Zn + 2Ag^+ \rightarrow Zn^{2+} + 2Ag$ [2]
Note: not balanced only [1]

(iii) because they can accept or gain electrons / change into atoms or can be reduced [1]

(iv) Ag^+ or silver [1]
charge not essential but if given must be correct

(v) Ag^+ and Cu^{2+} **or** silver and copper [1]
charge not essential but if given must be correct

(b) Cu Sn Cd Zn *(i.e. all **4** in correct order)* [1]
relates order to voltage [1]

one relevant comment from: [1]

higher reactivity metals are the negative electrode / copper is least reactive because it is the positive electrode because copper would have the lowest voltage / copper cell V = 0 / the bigger the difference in reactivity, the bigger the voltage / zinc has highest voltage because it is most reactive / more reactive metals have higher voltage

[Total: 9]

6 (a) (i) proton or H^+ acceptor [1]

(ii) (measure) pH or (use) UI indicator [1]
note: can be implied need not be explicit
sodium hydroxide has higher pH / ammonia(aq) has lower pH [1]
(this sentence would score 2 marks)
or
appropriate colours with UI / appropriate numerical values [1]
ammonia is closer to green, blue-green, turquoise or lighter blue
sodium hydroxide is darker blue / purple / violet [1]
or
measure electrical conductivity [1]
can be implied need not be explicit
ammonia (aq) is the poorer conductor/ sodium hydroxide is the better conductor [1]

(b) any five from:

- high pressure favours lower volume side / movement to right / ammonia side, **or** high pressure increases the yield
- high pressure increases rate
- low temperature favours exothermic reaction / increases yield / favours the forward reaction
- low temperature gives low rate or vice versa
- catalyst increases rate or lowers activation energy
- 450 °C low enough to give an economic yield but with catalyst gives a fast enough rate
  note need whole concept to get this compromise temperature point [5]

(c) $2NH_3 + NaClO \rightarrow N_2H_4 + NaCl + H_2O$ [2]
not balanced only 1

(d) 4 hydrogen atoms 1 bonding pair each [1]
2 nitrogen atoms with 1 bonding pair between them [1]
one non-bonding pair on each N (need not be seen as a pair) [1]

(e) **(i)** pH increases [1]

(ii) oxygen needed for rusting / removes oxygen / reacts with oxygen [1]

[Total: 15]

7 **(a)** **(i)** add carbon / animal charcoal [1]
filter [1]

OR

repeat experiment without indicator [1]
using same quantity / volume of acid [1]

(ii) add magnesium metal / carbonate / oxide / hydroxide
to (hot) (hydrochloric) acid [1]

cond: until in excess **or** no more dissolves **or** reacts [1]

cond: filter (to remove unreacted solid) [1]

(b) number of moles of HCl = 0.020 x 2.20 = 0.044 [1]
number of moles of LiOH = 0.044
concentration of LiOH = 0.044/0.025 = 1.769 (mol / dm^3) [1]
accept 1.75 to 1.77 need 2 dp
correct answer scores = 2

(c) (for LiCl.2H_2O)
mass of one mole = 78.5 [1]
percentage water = 36 / 78.5 x 100 [1]
45.9 so is LiCl.2H_2O [1]
only award the marks if you can follow the reasoning and it gives 45.9% of water

note: if correct option given mark this and ignore the rest of the response

allow: max 2 for applying a correct method to another hydrate, [1] for the method and [1] for the correct value, working essential

[Total: 10]

8 **(a)** **(i)** <u>regular</u> arrangement / repeating pattern **NOT** structure [1]
cond: ions [1]
not molecules / atoms

(ii) attraction between opposite charges / electrostatic attraction [1]

(b) delocalised / mobile / free / sea of electrons [1]
positive ions / cations
not atoms / protons / nuclei [1]
attraction between these electrons and ions [1]

(c) **giant covalent**
no ions [1]
no delocalised / free / mobile / sea of electrons **or** all electrons [1]

ionic
in ionic solid ions cannot move [1]
liquid ionic compound ions can move [1]

metallic
(both solid and liquid) metals have delocalised (**or** alternative term) electrons [1]

[Total: 11]