CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International General Certificate of Secondary Education

MARK SCHEME for the October/November 2014 series

0439 CHEMISTRY (US)

0439/31 Paper 3 (Extended Theory), maximum raw mark 80

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1 **(a)** Match the following pH values to the solutions given below.

1 3 7 10 13

The solutions all have the same concentration.

solution	pH
aqueous ammonia, weak base	10
dilute hydrochloric acid, a strong acid	1
aqueous sodium hydroxide, a strong base	13
aqueous sodium chloride, a salt	7
dilute ethanoic acid, a weak acid	3

[5]

(b) Hydrochloric acid strong acid **or** ethanoic acid weak acid [1]
OR: hydrochloric acid completely ionised **or** ethanoic acid partially ionised
hydrochloric acid greater concentration of/more H^+ ions (than ethanoic acid) [1]

(c) Rate of reaction with Ca, Mg, Zn, Fe [1]

Strong (hydrochloric) acid bubbles faster **or** more bubbles **or** dissolves faster [1]

OR: rate of reaction with (metal) carbonate [1]
strong (hydrochloric) acid faster **or** more bubbles **or** dissolves faster (only if carbonate insoluble) [1]

OR: electrical conductivity [1]
strong (hydrochloric) acid better conductor [1]

[Total: 9]

2 **(a)** soft because weak forces between layers/sheets/rows [1]

layers can slip/slide [1]

good conductor because electrons can move/mobile [1]

(b) it is soft: pencils **or** lubricant **or** polish [1]
good conductor: electrodes **or** brushes (in electric motors) [1]

(c) **(i)** every silicon atom is bonded/attached to 4 oxygen atoms or every oxygen bonded/attached to two silicon atoms [1]

(ii) Any **two** from:
high melting point/boiling point
hard
colourless crystals/shiny
poor/non-conductor of electricity/insulator
insoluble in water [2]

[Total: 8]

3 **(a)** Any **two** from:
bleach/making wood pulp/making paper
food/fruit juice/wine preservative
fumigant/sterilising/insecticide [1]

(b) heating/roasting/burning (zinc sulfides) [1]
in air/oxygen COND on M1 [1]

(c) **(i)** V_2O_5 [1]

(ii) position of equilibrium shifts right/yield increases [1]
to save energy [1]

(iii) faster reaction/rate [1]

more collisions per second/higher collision frequency [1]

fewer moles/molecules (of gas) on right [1]

(so) position of equilibrium shifts right/yield increases [1]

(d) (the reaction is) too violent/too exothermic **or** produces mist/fumes (of acid) [1]

[Total: 12]

4 **(a)** **(i)** insufficient/limited oxygen [1]
or $2C + O_2 \rightarrow 2CO$

coke/carbon reacts with carbon dioxide [1]
or $C + CO_2 \rightarrow 2CO$

(ii) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
species (1) balancing (1) [2]

(b) **(i)** carbon dioxide [1]

(ii) $CaO + SiO_2 \rightarrow CaSiO_3$ [2]
[1] each side correct

(iii) (molten) iron higher density (than slag) [2]

(iv) No oxygen in contact with iron **or** layer of slag prevents hot iron reacting with oxygen/air **or** (all) oxygen reacts with carbon (so no oxygen left to react with iron) [1]

(c) **(i)** air/oxygen and water (need both) [1]

(ii) aluminium oxide layer is impervious **or** non-porous **or** passive **or** unreactive **or** will not allow water/air to pass through it (rust allows passage of water **or** air **or** it flakes off)

(d) **(i)** zinc more reactive (than iron/steel) [1]
loses electrons [1]
electrons move (from zinc) to iron [1]
Zinc reacts (with air and water) **or** zinc corrodes **or** zinc is oxidised **or** zinc is anodic **or** zinc forms positive ions **or** zinc forms Zn^{2+} **or** iron and steel don't react with air/water **or** iron and steel are not oxidised **or** iron and steel do not form ions **or** iron and steel do not lose electrons **or** iron and steel are cathodic [1]

(ii) R to L in wire [1]

(iii) $2H^+ + 2e^- \rightarrow H_2$
species (1) balancing (1)

[Total: 19]

5 **(a)** nitrogen and oxygen react [1]
at high temperatures (in engine) [1]

(b) M1 carbon monoxide (converted to) carbon dioxide **or** $2CO + O_2 \rightarrow 2CO_2$ [1]

M2 (by) oxides of nitrogen (which are reduced to) nitrogen
or $2NO \rightarrow N_2 + O_2$ **or** $2NO_2 \rightarrow N_2 + 2O_2$ [1]

M3 hydrocarbons (burn) making water [1]

M4 products: any **two** from:
carbon dioxide, water, nitrogen [1]

(c) lead compounds are toxic **or** brain damage **or** reduce IQ or nausea or kidney failure **or** anaemia [1]

[Total: 7]

6 **(a)** **(i)** butanoic acid [1]
methanol [1]

(ii) number of moles of ethanoic acid = 0.1 [1]
number of moles of ethanol = 0.12(0) [1]
the limiting reagent is ethanoic acid [1]
number of moles of ethyl ethanoate formed = 0.1 [1]
maximum yield of ethyl ethanoate is 8.8 g [1]

(b) correct ester linkage [1]
two ester linkages (COND on M1)
continuation (COND on M2)

(c) **(i)** add bromine water/bromine [1]
turns colourless [1]
remains brown/orange/reddish brown/yellow [1]

ALLOW: potassium manganate(VII) (acidic or alkaline) [1]
correct colour colourless/green or brown ppt [1]
stays pink/purple [1]

(ii) ester 1 [1]
COND alkyl group is C_nH_{2n+1} which is NOT $C_{17}H_{33}$
or $C_{17}H_{35}$ is C_nH_{2n+1} **or** less hydrogen [1]

(iii) soap **or** (sodium) salt (of a carboxylic acid) **or** carboxylate [1]

alcohol [1]

[Total: 17]

7 **(a)** **(i)** $6Li + N_2 = 2Li_3N$
species (1) balancing (1)

(ii) N^{3-} ion drawn correctly [1]

Charges correct (minimum 1 × Li ion and 1 nitride ion) [1]

(b) **(i)** 3 × shared pairs between N and 3 × F [1]

only 2 non-bonding electrons on N, 6 non-bonding electrons on each F
(COND on first point) [1]

(ii) Strong attractive forces/strong ionic bonds in lithium nitride [1]

weak (attractive) forces between molecules in NF_3 [1]

[Total: 8]