CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the October/November 2013 series

0620 CHEMISTRY

0620/33 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.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

1 (a) same number of protons [1]
same number of electrons [1]
different number of neutrons [1]

(b) (i) ^{235}U / ^{239}Pu [1]
NOTE: need symbol or name and nucleon number

(ii) treating cancer / chemotherapy / radiographs / tracer studies / x–ray (scans) / sterilise surgical instruments / diagnose or treat thyroid disorders / radiotherapy [1]

paper thickness / steel thickness / radiographs / welds / tracing / fill levels in packages / food irradiation / smoke detectors [1]
ACCEPT: any other uses

(iii) $Zr + 2H_2O \rightarrow ZrO_2 + 2H_2$ [2]
not balanced = (1) only

(iv) hydrogen explodes / fire (risk) [1]

(c)

if the oxide is	predicted result with hydrochloric acid	predicted result with aqueous aqueous sodium hydroxide
acidic	NR	R
neutral	NR	NR
basic	R	NR
amphoteric	R	R

(1) per line [4]

[Total: 13]

2 **(a)** **(i)** positive **and** negative ions [1]
regular pattern / opposite charges closer than the same charge [1]

(ii) so that charges cancel / ions may not have the same charge [1]

(iii) Any **three** of:
high melting point or boiling point
hard
brittle
soluble in water / insoluble in organic solvents
conduct (electricity) in liquid state **or** in aqueous solution / non-conductors or poor conductor (when solid) [3]

(b) correct formula [1]
correct charges [1]
6x and 2o around oxygen [1]

[Total: 9]

3 **(a)** **(i)** roast or heat or burn in air / roast or heat or burn in oxygen [1]
need both of the above

(ii) $ZnO + C \rightarrow Zn + CO$ / $2ZnO + C \rightarrow 2Zn + CO2$ / $ZnO + CO \rightarrow Zn + CO_2$ [1]

(b) **(i)** $ZnO + H_2SO_4 \rightarrow ZnSO_4 + H_2O$ [1]

(ii) zinc reduces / gives electrons / displaces (copper / cobalt / nickel ions) [1]

forming copper / cobalt / nickel (metal which is precipitated) [1]

(c) **(i)** $Zn^{2+} + 2e \rightarrow Zn$ [1]

(ii) $OH^- \rightarrow 2H_2O + O_2 + ...e$ (1) only
$4OH^- \rightarrow 2H_2O + O_2 + 4e$ [2]

(iii) sulfuric acid / hydrogen sulfate [1]
ACCEPT: sulfuric acid

(d) (i) Any two of:
appearance
more resistant to corrosion
harder (accept stronger)
easier to cast [2]

(ii) zinc more reactive (than iron or steel) [1]
zinc loses electrons [1]
electrons move (from zinc) to iron [1]
zinc reacts (with air and water) / zinc corrodes / is oxidised / forms positive ions / anodic
or
iron and steel don't react (with air and water) / not oxidised / do not form ions / do not lose electrons [1]

[Total: 15]

4 (a) (i) $S + O_2 \rightarrow SO_2$
or sulfur burnt / roasted / heated in air to form sulfur dioxide [1]

$2SO_2 + O_2 \rightleftharpoons 2SO_3$ [2]
unbalanced = (1) only

(catalyst) vanadium(V) oxide / vanadium pentoxide [1]
(temperature) 440 to 460 °C [1]
(dissolve) sulfur trioxide in sulfuric acid (to form oleum) [1]
ignore comments about pressure

(ii) add oleum to water [1]

(b) $Ba(C_6H_{13}SO_3)_2$ / $(C_6H_{13}SO_3)_2Ba$ [1]

(c) (i) → magnesium hexanesulfonate + hydrogen [1]

(ii) → calcium hexanesulfonate + water [1]

(iii) $2C_6H_{13}SO_3H + Na_2CO_3 \rightarrow 2C_6H_{13}SO_3Na + CO_2 + H_2O$

$C_6H_{13}SO_3Na$ = (1) [1]
remaining species correct and equation balanced = (1) [1]

(d) (i) measure pH / add universal indicator [1]
both acids have a low value / pH 0–2 / same colour / red [1]
or
measure rate with named reactive metal, Mg, Zn (1)
both fast reactions (1)
or
measure rate using piece of insoluble carbonate, $CaCO_3$ (1)
both fast reactions (1)
NOTE: must be insoluble for first mark
or
measure electrical conductivity (1)
both good conductors (1)

(ii) to have same concentration of H^+ / one acid is H_2SO_4, the other is $C_6H_{13}SO_3H$ / sulfuric acid is dibasic, hexanesulfonic is monobasic [1]

(iii) a strong acid is completely ionised, [1]
a weak acid is partially ionised [1]

[Total: 17]

5 (a) protective / layer **and** of oxide [1]

(b) correct repeat unit [1]
continuation shown [1]

(c) (i) catalyst [1]
biological / protein [1]

(ii) hydrochloric acid / any strong acid / any strong alkali [1]

(iii) amino acids [1]

(iv) chromatography [1]

(v) nylon / kevlar [1]

(d) (i) non-biodegradable [1]

(ii) $CH_2=CH(C_6H_5)$ [1]

[Total: 11]

6 (a) (i) $CH_3–CH_2–CH_2–OH$ [1]
NOT: C_3H_8O
between 2030 and 2050 [1]

(ii) $C_5H_{11}OH + 7½\ O_2 \rightarrow 5CO_2 + 6H_2O$ [1]

(b) any three from:
same general formula
same functional group
same chemical properties
same methods of preparation
accept consecutive members differ by CH_2 [3]

(c) (i) same molecular formula [1]
different structures / different structural formulae [1]

(ii) $CH_3–CH_2–CH(OH)–CH_3$ / $(CH_3)_3C–OH$ [1]

(d) (i) number of moles of glucose = 72/180 = 0.4 [1]
maximum number of moles ethanol = 0.8 [1]
maximum mass of ethanol, M_r = 46 g, 0.8 × 46 = 36.8 g [1]
or
180 (g) produces 2 × 46 = 92 (g) (1)
(72 (g) produces) 72/180 × 92 (1)
= 36.8 (g) (1)

(ii) crack (petroleum or alkane) [1]
react with water / hydrate (ethene to make ethanol) [1]

conditions for cracking
(temperature) 450to 800 °C / (catalyst) zeolites / aluminosilicates / silica / aluminium oxide / alumina / china / broken pot / chromium oxide
or
conditions for hydration
(temperature) 300 °C / (pressure) 60 atmospheres /
(catalyst) phosphoric acid [1]

[Total: 15]