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

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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]

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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

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(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]

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(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]

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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]

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