

CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

MARK SCHEME for the October/November 2013 series

0439 CHEMISTRY (US)

0439/31

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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- 1 (a) uranium / plutonium / thorium
- (b) graphite / carbon
- (c) platinum / titanium / mercury / gold [1]
NOT: carbon / graphite
- (d) helium [1]
- (e) nitrogen / phosphorus [1]
- (f) argon [1]
ACCEPT: any ion 2 + 8 + 8 e.g. K⁺ etc.
- (g) tellurium [1]
ACCEPT: correct symbol
- [Total: 7]**
- 2 (a) Any three of:
 iron is harder
 iron has higher density
ACCEPT: heavier **or** potassium lighter
 iron has higher mp **or** bp
 iron has higher tensile strength **or** stronger
 iron has magnetic properties [3]
NOTE: has to be comparison, e.g. iron is hard (0) but iron is harder (1)
NOT: appearance e.g. shiny
ACCEPT: comparative statements relating to potassium
- (b) potassium hydrogen (1) and potassium hydroxide (1)
 zinc hydrogen (1) and zinc oxide (1)
 copper no reaction (1) [5]
- [Total: 8]**

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- 3 (a) (i) fractional distillation (liquid) air
- (ii) cracking / heat in presence of catalyst of alkane / petroleum to give an alkene and hydrogen [1]
[1]
- OR:** electrolysis (1)
named electrolyte (1)
hydrogen at cathode (1)
- OR:** from methane (1)
react water / steam (1)
heat catalyst (1)
only **ACCEPT:** water with methane **or** electrolysis
- (b) (i) the pair with both graphs correct is C [1]
NOTE: mark (b)(ii) independent of (b)(i)
- (ii) high pressure favours side with lower volume / fewer moles [1]
this is RHS / product / ammonia [1]
%NH₃ / yield increases as pressure increases [1]
- the forward reaction is exothermic [1]
exothermic reactions favoured by low temperatures [1]
%NH₃ / yield decreases as temperature increases [1]
ACCEPT: reverse arguments
- (iii) increases reaction rate [1]
ACCEPT: reduces activation energy [1]
OR: decreases the amount of energy particles need to react
OR: economic rate at lower temperature so higher yield
- [Total: 14]**
- 4 (a) (i) (mass at t = 0) – (mass at t = 5) [1]
NOTE: must have mass at t = 5 not final mass
- (ii) fastest at origin
slowing down between origin and flat section gradient = 0
where gradient = 0
three of above in approximately the correct positions [2]
- (iii) 3 correct comments about gradient = [2]
2 correct comments about gradient = [1]
1 correct comment about gradient = [0] [2]
- (b) start at origin and smaller gradient [1]
same final mass just approximate rather than exact [1]

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- (c) (i) smaller surface area
lower collision rate
- (ii) molecules have more energy
collide more frequently / more molecules have enough energy to react [1]
- (d) number of moles of HCl in 40 cm³ of hydrochloric acid, [1]
concentration 2.0 mol / dm³ = 0.04 × 2.0 = 0.08 [1]
maximum number of moles of CO₂ formed = 0.04 [1]
mass of one mole of CO₂ = 44 g [1]
maximum mass of CO₂ lost = 0.04 × 44 = 1.76 g [1]

[Total: 15]

- 5 (a) (i) have same molecular formula / both are C₅H₁₂ [1]
they have different structural formulae / different structures [1]
- (ii) CH₃-CH₂-CH=CH-CH₃ / any other correct isomer [1]
- (b) (i) CH₂-(Br)-CH₂Br [1]
NOT: C₂H₄Br₂
dibromoethane [1]
NOTE: numbers not required but if given must be 1, 2
- (ii) CH₃-CH₂-CH₃ [1]
NOT: C₃H₈
propane [1]
- (iii) CH₃-CH₂-CH₂-CH₂-OH / CH₃-CH₂-CH(OH)-CH₃ [1]
butanol [1]
numbers not required but if given must be correct and match formula
- (c) (i) CH₃-CH=CH-CH₂-CH₃ [1]
CH₃-CH=CH-CH₃ [1]
- (ii) pink / purple [1]
colourless [1]
NOT: clear
- (d) -CH₂-CH(CN)-CH₂-CH(CN)- [1]
correct repeat unit CH₂-CH(CN) [1]
COND: at least 2 units in diagram [1]
continuation [1]

[Total:16]

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- 6 (a) (i) (attractive force between) positive ions
and (negative) electrons
opposite charges attract ONLY [1]
electrostatic attraction ONLY [1]
- (ii) lattice / rows / layers of lead ions / cations / positive ions [1]
NOT: atoms / protons / nuclei
can slide past each other / the bonds are non-directional [1]
- (b) (i) anhydrous cobalt chloride becomes hydrated [1]
ACCEPT: hydrous
- (ii) carbon dioxide is acidic [1]
sodium hydroxide and calcium oxide are bases / alkalis [1]
- (iii) Any two of:
water, calcium carbonate and sodium carbonate [2]
ACCEPT: sodium bicarbonate
- (c) number of moles of CO₂ formed = 2.112 / 44 = 0.048 [1]
number of moles of H₂O formed = 0.432 / 18 = 0.024 [1]
- x = 2 and y = 1 **NOT:** ecf from this line
- formula is 2PbCO₃.Pb(OH)₂ / Pb(OH)₂. 2PbCO₃ [1]
- [Total:12]**
- 7 (a) (i) hydrogen (atoms) replaced by (atoms) of a different element e.g. chlorine [1]
NOT: substitute
- (ii) light required [1]
- (b) exothermic reaction gives out energy [1]
endothermic reaction absorbs
takes in energy [1]
- (c) bonds broken energy
C-H +412
C-Cl +242
total energy +654 [1]
- bonds formed energy
C-Cl -338
H-Cl -431
total energy -769 [1]
energy change -115 [1]
negative sign indicates exothermic [1]

[Total: 8]