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CHEMISTRY (US)

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Paper 3 Core Theory

October/November 2016

MARK SCHEME

Maximum Mark: 80

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This document consists of **8** printed pages.

Page 2	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
1(a)(i)	H / hydrogen	1
1(a)(ii)	H / hydrogen	1
1(a)(iii)	S / sulfur	1
1(a)(iv)	Ca / calcium	1
1(a)(v)	Al / aluminium	1
1(b)(i)	atoms with the same number of protons but different <u>number</u> of neutrons OR atoms of the same element with different <u>number</u> of neutrons	1 1 1 1
1(b)(ii)	124	1
1(b)(iii)	80	1
1(b)(iv)	78	1

Page 3	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
2(a)(i)	any 2 from: <ul style="list-style-type: none"> • more Na^+ ions in sample B OR A • more Cl^- ions in sample B OR A • more Mg^{2+} ions in sample B OR A • more HCO_3^- ions in sample A OR A • more Ca^{2+} ions in sample A OR A • more K^+ ions in sample A OR A • more SiO_3^{2-} ions in sample A OR A 	2
2(a)(ii)	Mg^{2+}	1
2(a)(iii)	2 mg = [2] $\frac{200}{1000} \times (10) = [1]$ OR $0.2 \times (10) = [1]$	2
2(b)	<i>test:</i> flame test / description of flame test <i>result:</i> yellow (flame)	2
2(c)	Brownian (motion)	1
2(d)(i)	indicates a reversible reaction	1
2(d)(ii)	dip (indicator) paper in solution / put (indicator paper) in solution compare the colour with the (colour) chart / different colours represent different pH values	1 1
2(d)(iii)	absorbs heat / absorbs infra-red radiation / causes global warming	1
2(d)(iv)	<i>gas:</i> methane <i>source:</i> gases from (digestion in) animals / swamps / decomposition of vegetation / rice paddy fields / fracking / melting of permafrost /	1 1

Page 4	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
3(a)	2 electrons in the outer shell inner shells correct (2, 8, 8)	1 1
3(b)	cathode electrolyte anode	2
3(c)	H ₂ (on right) 2(H ₂ O) (on left)	1 1
3(d)	<p><i>manufacture</i> (max = [2])</p> <ul style="list-style-type: none"> • limestone / calcium carbonate heated • thermal decomposition • heated in kiln / heated in current of air / coke for heating / carbon for heating <p><i>uses</i> (max = [2])</p> <ul style="list-style-type: none"> • neutralise acidic waste / treating flue gases • neutralise acidic soils • steelmaking / removing impurities in iron • (lime) mortar / cement / plaster / lime wash • slaked lime / limewater <p><i>equation</i> (max = [2])</p> <ul style="list-style-type: none"> • e.g. calcium carbonate → calcium oxide + carbon dioxide • calcium oxide + acid → calcium salt + water 	4

Page 5	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
4(a)	any 3 from: <ul style="list-style-type: none"> • diffusion • particles move / motion of particles • (movement is) random / in any direction / in all directions • particles spread out / particles mix • particles move from high to low concentration 	3
4(b)(i)	energy (production) / power (production)	1
4(b)(ii)	any suitable use, e.g. treatment of cancer / tracer / thyroid function / sterilising (medical) instruments /	1
4(b)(iii)	average mass of <u>atoms</u> (of an element) (on a scale where) the ^{12}C atom has a mass of (exactly) 12 (units)	1 1
4(c)(i)	Cl_2 (on left) $2(\text{KCl})$ (on right)	1 1
4(c)(ii)	any suitable use, e.g. sterilising / killing bacteria / swimming pools / bleach /	1
4(c)(iii)	<u>acidic</u> because chlorine is a non-metal / <u>acidic</u> because chlorine is on the right of the Periodic Table	1
4(c)(iv)	goes colourless / bleached / (goes) white	1

Page 6	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
5(a)(i)	the more carbon, the higher the strength ORA	1
5(a)(ii)	(no) the melting point range does not increase regularly / the melting point range goes up and down / the melting point range remains fairly constant OR (yes) the more carbon, the greater the melting point range / the difference between the higher and lower number is greater with more carbon OR (yes) the average melting point range is higher the more carbon (except for D) / the general trend is for a higher melting point range with more carbon	1
5(a)(iii)	D because it is resistant to corrosion	1
5(b)	A	1
5(c)(i)	gives strength / so the wire does not break / so the wire does not sag / for support	1
5(c)(ii)	<i>use</i> : any suitable use, e.g. food container / saucepan / aircraft body / <i>property</i> : any suitable property related to the use, e.g. (food container) resistant to acidic foods / (saucepan) good conductor of heat / (aircraft body) low density /	1 1
5(d)(i)	Al / aluminium it gains oxygen	1 1
5(d)(ii)	<u>exothermic</u> because the reactants have more energy than the products / <u>exothermic</u> because the products have less energy than the reactants	1

Page 7	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
6(a)	<p><i>effect on indicator</i> (max = [1])</p> <ul style="list-style-type: none"> • turn (blue) litmus red • turn methyl orange red / pink <p><i>reaction with metals</i> (max = [1])</p> <ul style="list-style-type: none"> • react with metals to produce hydrogen • react with metals to form a salt <p><i>reaction with bases</i> (max = [1])</p> <ul style="list-style-type: none"> • react with bases to form a salt and water <p><i>reaction with carbonates</i> (max = [1])</p> <ul style="list-style-type: none"> • react with carbonates to form a salt and water • react with carbonates to form carbon dioxide <p><i>one other effect / reaction</i> (max = [1])</p> <ul style="list-style-type: none"> • e.g. have a sour taste / pH below 7 / another property selected from the bullet points above 	4
6(b)(i)	density decreases as the number of carbon atoms increases ORA	1
6(b)(ii)	values between and including 170 (°C)–220 (°C)	1
6(b)(iii)	solid its melting point is above 15 °C / 15 °C is below its melting point	1 1
6(b)(iv)	displayed structure of COOH group showing all of the atoms and all of the bonds	1
6(b)(v)	88 4 × C OR 8 × H OR 2 × O OR C = 48 OR O = 32 scores [1]	2
6(c)	physical / chemical / physical	2

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Question	Answer	Mark
7(a)	A = melting / fusion B = boiling / vaporisation	1 1
7(b)	<i>arrangement</i> : irregular / random / no fixed position / no (fixed) arrangement <i>motion</i> : rapid / fast / random	2
7(c)	any suitable use, e.g. tyre manufacture / making sulfur dioxide / making sulfuric acid / pesticide / insecticide /	1
7(d)	sulfur dioxide is formed sulfur dioxide causes irritation of the throat (OR nose OR lungs OR eyes or skin)	1 1
7(e)(i)	C ₄ H ₄ S	1
7(e)(ii)	speeds up the rate of a reaction	1
7(e)(iii)	25.2 (g)	1