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Cambridge International General Certificate of Secondary Education

MARK SCHEME for the February/March 2016 series

0620 CHEMISTRY

0620/42

Paper 4 (Extended Theory), maximum raw mark 80

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Page 2	Downloaded from eduresourceza.com Mark Scheme	Syllabus	Paper
	Cambridge IGCSE – February/March 2016	0620	42

Abbreviations used in the Mark Scheme

- ; separates marking points
- / separates alternatives within a marking point
- () the word or phrase in brackets is not required but sets the context
- **A** accept (a less than ideal answer which should be marked correct)
- **I** ignore (mark as if this material were not present)
- **R** reject
- ecf credit a correct statement that follows a previous wrong response
- ora or reverse argument
- owtte or words to that effect (accept other ways of expressing the same idea)

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge IGCSE – February/March 2016	0620	42

Question	Answer	Marks									
1(a)	B = 17; C = 18; D = 2,8; 2 ⁻ /2 ⁻ ;	4									
1(b)	Substance that cannot be broken down into anything simpler / substance that cannot be broken down (by chemical means) / substance containing atoms with the same atomic number or proton number;	1									
1(c)	<table border="1"> <thead> <tr> <th>number of protons</th><th>number of neutrons</th><th>number of electrons</th></tr> </thead> <tbody> <tr> <td>31</td><td>38</td><td>31</td></tr> <tr> <td>31</td><td>40</td><td>31</td></tr> </tbody> </table> M1 column one; M2 column two; M3 column three;	number of protons	number of neutrons	number of electrons	31	38	31	31	40	31	3
number of protons	number of neutrons	number of electrons									
31	38	31									
31	40	31									

Question	Answer	Marks
2(a)	1;	1
2(b)	conducts electricity or heat / malleable / ductile / sonorous / shiny;	1
2(c)	any two from: (low) melting point / (low) boiling point; - hardness / softness / rubidium can be cut easily; - strength; (low) density;	2

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge IGCSE – February/March 2016	0620	42

Question	Answer	Marks
2(d)(i)	any two from: - bubbles / effervescence / fizzing; - flame / sparks / ignites; - movement; - dissolves / forms a solution / disappears / gets smaller; - floats; - rubidium melts / rubidium forms a ball; - explosion;	2
2(d)(ii)	yellow;	1
2(d)(iii)	$2\text{Rb} + 2\text{H}_2\text{O} \rightarrow 2\text{RbOH} + \text{H}_2$ formula of RbOH; whole equation completely correct;	2
2(d)(iv)	caesium $\rightarrow$ rubidium $\rightarrow$ potassium $\rightarrow$ sodium $\rightarrow$ lithium / Cs $\rightarrow$ Rb $\rightarrow$ K $\rightarrow$ Na $\rightarrow$ Li;	1
2(d)(v)	goggles / glasses / gloves / safety screen / stand at safe distance / tongs / open space;	1
2(e)	Rb_3PO_4 ;	1

Question	Answer		Marks
3(a)	CO ₂ ;		4
		solid;	
		poor conductor / non-conductor;	
	simple molecular / simple (covalent);		
3(b)(i)	covalent;		1

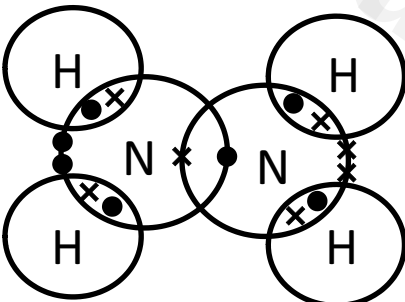
Page 5	Mark Scheme	Syllabus	Paper
	Cambridge IGCSE – February/March 2016	0620	42

Question	Answer	Marks
3(b)(ii)	all bonds are (very) strong or bonds; or bonds need a lot of energy or heat to break; or (there are) no weak bonds/no (weak) intermolecular forces;	1
3(b)(iii)	weak forces between molecules; or weak intermolecular forces or weak van der Waals' forces; or low amount of energy needed to break intermolecular/van der Waals' forces;	1
3(b)(iv)	no (moving) ions/no mobile or moving electrons/all electrons used in bonding/ made of uncharged molecules;	1
3(c)	$2\text{NaOH} + \text{CO}_2 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$ or $\text{NaOH} + \text{CO}_2 \rightarrow \text{NaHCO}_3$ formula of Na_2CO_3 / NaHCO_3 ; whole equation correct;	2
3(d)(i)	(complete) combustion/burning;	1
3(d)(ii)	photosynthesis;	1
3(d)(iii)	respiration;	1

Page 6	Mark Scheme	Syllabus	Paper
	Cambridge IGCSE – February/March 2016	0620	42

Question	Answer	Marks
4(a)	M1 (substance that) speeds up a reaction/increases the rate of a reaction; M2 any one from: unchanged (chemically at the end)/not used up; lowers activation energy;	2
4(b)(i)	at the start/initially / $t = 0$;	1
4(b)(ii)	catalyst should be powdered/increase surface area (of catalyst)/decrease particle size (of catalyst); or increase temperature/heat/warm;	1
4(c)(i)	0.002 (mol);	1
4(c)(ii)	0.001 (mol);	1
4(c)(iii)	0.024 (dm ³);	1
4(c)(iv)	no change/no effect;	1
4(c)(v)	0.048 (dm ³);	1
4(d)	same mass/amount of/ moles/ 1.0 g of catalyst; same temperature; same volume and concentration of hydrogen peroxide/ 20 cm ³ of 0.1 mol/dm ³ of hydrogen peroxide or reactant;	3

Page 7	Mark Scheme	Syllabus	Paper
	Cambridge IGCSE – February/March 2016	0620	42

Question	Answer	Marks
5(a)(i)	pressure in range 150–300 atmospheres/atm; temperature in range 370–470 °C; iron (catalyst); balanced equation: $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$; equilibrium/reversible;	5
5(a)(ii)	manufacture of fertilisers/nylon/nitric acid/cleaning agent(allow oven cleaner)/hair dye/urea/refrigeration/explosives;	1
5(b)	 M1 all shared electrons correct (5 bonds); M2 exactly two non-bonding electrons on each N and no additional non-bonding electrons;	2
5(c)(i)	proton/ H^+ acceptor;	1
5(c)(ii)	$(\text{N}_2\text{H}_4 + \text{H}_2\text{O}) \rightarrow \text{N}_2\text{H}_5^+ + \text{OH}^-$; or $(\text{N}_2\text{H}_4) + 2\text{H}_2\text{O} \rightarrow \text{N}_2\text{H}_6^{2+} + 2\text{OH}^-$;	1
5(d)(i)	acid rain/effect of acid rain/(photochemical) smog/(producing) low level ozone;	1
5(d)(ii)	M1 nitrogen and oxygen (from the air) react/combine or word equation; M2 at high temperature/spark/very hot;	2

Page 8	Mark Scheme	Syllabus	Paper
	Cambridge IGCSE – February/March 2016	0620	42

Question	Answer	Marks
6(a)	S ₂ ²⁻ ; or S ⁻ ;	1
6(b)	test conductivity; gold conducts/ora; or malleability/hit with a hammer; gold malleable/only gold produces ringing sound/ora; or density; gold denser/ora; or add acid/any named/formula of acid; gold does not react (ignore products with pyrites)/ora; or heat (both strongly) in air/oxygen; iron pyrite reacts (ignore products); or melting point; gold lower/ora; or heat with a more reactive metal than iron; gold does not react/ora;	2
6(c)(i)	4FeS ₂ + 11O ₂ → 2Fe ₂ O ₃ + 8SO ₂ all formulae; balancing;	2

Page 9	Mark Scheme	Syllabus	Paper
	Cambridge IGCSE – February/March 2016	0620	42

Question	Answer	Marks
6(c)(ii)	bleaching (in the manufacture of) wood pulp (for paper or straw or wool or cotton)/(food) preservative or killing bacteria in food or wine / fumigant / refrigerant / tanning(leather);	1

Question	Answer	Marks				
7(a)(i)	compound containing carbon and hydrogen only;	1				
7(a)(ii)	C_nH_{2n+2} ; C_nH_{2n} ;	2				
7(b)(i)	mol C = 54.54 / 12 or 4.5(45) and mol H = 9.09 / 1 or 9.09 and mol O = 36.37 / 16 or 2.27; C_2H_4O ;	2				
7(b)(ii)	M_r of C_2H_4O = 44; 88 / 44 = 2 therefore $C_4H_8O_2$;	2				
7(c)	<table><tr><td>methyl ethanoate;</td><td>ethyl methanoate;</td></tr><tr><td>CH_3COOCH_3;</td><td>$HCOOC_2H_5$;</td></tr></table>	methyl ethanoate;	ethyl methanoate;	CH_3COOCH_3 ;	$HCOOC_2H_5$;	4
methyl ethanoate;	ethyl methanoate;					
CH_3COOCH_3 ;	$HCOOC_2H_5$;					
7(d)	methyl propanoate;	1				
7(e)(i)	condensation;	1				
7(e)(ii)	water / H_2O ;	1				
7(e)(iii)	dicarboxylic acid or diacyl chloride; diol;	2				