CAMBRIDGE INTERNATIONAL EXAMINATIONS

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

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 February/March 2016 series for most Cambridge IGCSE® and Cambridge International A and AS Level components.

CAMBRIDGE
International Examinations

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)

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><tr><th>number of protons</th><th>number of neutrons</th><th>number of electrons</th></tr><tr><td>31</td><td>38</td><td>31</td></tr><tr><td>31</td><td>40</td><td>31</td></tr></table> **M1** column one; **M2** column two; **M3** column three;	**3**

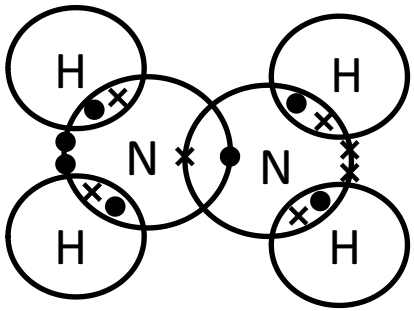
Question	Answer	Marks
2(a)	1;	**1**
2(b)	conducts electricity or heat / malleable / ductile / sonorous / shiny;	**1**
2(c)	any two from: • (low) melting point / (low) boiling point; • hardness / softness / rubidium can be cut easily; • strength; • (low) density;	**2**

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)	$2Rb + 2H_2O \rightarrow 2RbOH + H_2$ formula of RbOH; whole equation completely correct;	**2**
2(d)(iv)	caesium → rubidium → potassium → sodium → lithium / Cs → Rb → K → Na → 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**

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)	$2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$ **or** $NaOH + CO_2 \rightarrow NaHCO_3$ 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**

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**

Question	Answer	Marks
5(a)(i)	pressure in range 150–300 atmospheres / atm; temperature in range 370–470 °C; iron (catalyst); balanced equation: $N_2 + 3H_2 \rightarrow 2NH_3$; 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)	$(N_2H_4 + H_2O) \rightarrow N_2H_5^+ + OH^-$; **or** $(N_2H_4) + 2H_2O \rightarrow N_2H_6^{2+} + 2OH^-$;	**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**

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)	$4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$ all formulae; balancing;	**2**

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)	methyl ethanoate; / CH_3COOCH_3; and ethyl methanoate; / $HCOOC_2H_5$;	4
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