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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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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)

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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**

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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; / solid; / poor conductor / non-conductor; / simple molecular / simple (covalent);	**4**
3(b)(i)	covalent;	**1**

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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**

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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**

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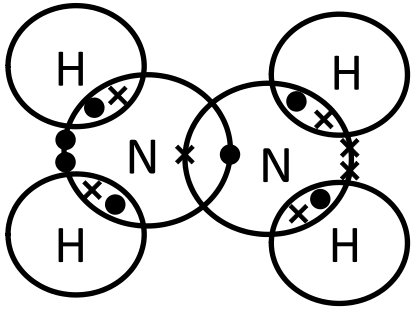
Question	Answer	Marks
5(a)(i)	pressure in range 150–300 atmospheres / atm; temperature in range 370–470 °C; iron (catalyst); balanced equation: $N_2 + 3H_2 \rightarrow 2NH_3$; equilibrium / reversible;	**5**
5(a)(ii)	manufacture of fertilisers / nylon / nitric acid / cleaning agent(allow oven cleaner) / 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**

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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**

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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

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