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CHEMISTRY **0620/42**

Paper 4 Extended Theory **October/November 2017**

MARK SCHEME

Maximum Mark: 80

Published

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Question	Answer	Marks
1(a)(i)	Brownian (motion)	**1**
1(a)(ii)	molecules	**1**
	nitrogen / N_2 / N **OR** oxygen / O_2 / O	**1**
1(a)(iii)	nitrogen **OR** oxygen (particles) collide with / bombard / hit the dust (particles)	**1**
	(the bombarding particles) move **randomly**	**1**
1(b)(i)	diffusion	**1**
1(b)(ii)	Br_2 has an M_r of 160 **AND** Cl_2 has an M_r of 71 / bromine has an A_r of 80 **AND** chlorine has an A_r of 35.5	**1**
	(heavier) bromine (molecules / particles) diffuses more slowly	**1**
1(b)(iii)	particles have more energy / move faster	**1**

Question	Answer	Marks
2(a)	*Si:* 2: 8 : 4	**1**
	Ca^{2+}: 2 : 8: 8	**1**
	N^{3-}: 2 : 8	**1**
2(b)	Ca_3N_2	**1**
2(c)	Li shown as having one shell with 2 electrons **OR** no electrons **OR** no outer shell	**1**
	C*l* shown as having an outer shell of 7 electrons of one type, plus one different electron which matches Li electrons	**1**
	'+' charge on Li **AND** '–' charge on C*l*	**1**

Question	Answer	Marks
2(d)	two shared pairs of electrons	**1**
	both C*l* with complete outer shells	**1**
	S with complete outer shell	**1**
2(e)	SCl_2 has intermolecular forces (of attraction)	**1**
	LiC*l* has (electrostatic) forces (of attraction) between ions	**1**
	intermolecular forces are weaker / less energy is needed to break intermolecular forces	**1**
2(f)	silicon(IV) oxide	**1**

Question	Answer	Marks
3(a)	*exothermic mark*: horizontal line representing the energy of the products below the energy of the reactants	**1**
	label of products mark: product line labelled with $2CO_2$ + $3H_2O$	**1**
	correct direction of vertical heat of reaction arrow: arrow starts level with reactant energy and finishes level with product energy **AND** has (only) **one** arrow head	**1**
3(b)	activation energy / E_a	**1**

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Question	Answer	Marks
3(c)	–650 kJ / mol **M1** bonds broken 2 × ((3 × 410) + 360 + 460) + (3 × 500) 2 × (1230 + 360 + 460) + 1500 2 × 2050 + 1500 4100 + 1500 = 5600 **M2** bonds formed (2 × (2 × 805)) + (4 × (2 × 460)) 2 × 1610 + 4 × 920 3220 + 3680 = 6900 **M3** = **M1** – **M2** energy change of reaction = 5600 – 6900 = –1300 **M4** = **M3** / 2	**4**
3(d)(i)	cracking	**1**
3(d)(ii)	$C_{12}H_{26} \rightarrow 3C_2H_4 + C_6H_{14}$ **M1** $C_{12}H_{26}$ **M2** rest of equation	**2**
3(d)(iii)	phosphoric acid	**1**
	heat	**1**
3(d)(iv)	addition / hydration	**1**
3(d)(v)	measure its boiling temperature	**1**
	compare to (known) data	**1**
3(e)(i)	any 2 from: • 37 °C • anaerobic • glucose is aqueous • yeast	**2**

Question	Answer	Marks
3(e)(ii)	$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ **M1** CO_2 as a product **M2** Rest of equation	**2**
3(e)(iii)	yeast is killed by the ethanol	**1**
3(e)(v)	slow rate of reaction	**1**
3(e)(v)	uses renewable resources / does not use a finite resource	**1**
3(e)(vi)	fractional distillation	**1**
3(f)(i)	CH_3O	**1**
3(f)(ii)	no (C=C) double bonds	**1**
3(f)(iii)	at least two alternating rectangles with attempted linking	**1**
	one displayed ester link (all atoms and all bonds)	**1**
	fully correct structure with at least one repeat unit including continuation bonds from correct atom or rectangle	**1**
3(f)(iv)	polyester	**1**

Question	Answer	Marks
4(a)	the breakdown (into elements)	**1**
	of an (ionic) compound by (the passage of) electricity	**1**
4(b)(i)	oxygen	**1**
4(b)(ii)	**glowing** splint	**1**
	relights	**1**

Question	Answer	Marks
4(b)(iii)	$2H^+ + 2e^- \rightarrow H_2$ **M1** gain of electrons by H^+ **M2** rest of equation	**2**
4(c)	*the wires:* electrons	**1**
	the electrolyte: ions	**1**
4(d)	any 2 from: • green gas at positive electrode • bulb is brighter • rate of bubbles increases	**2**
4(e)(i)	*anode made of:* impure copper	**1**
	cathode made of: (pure) copper	**1**
	electrolyte of: (aqueous) copper sulfate	**1**
4(e)(ii)	silver (impurities) fall to the bottom of the cell	**1**
	zinc (impurities) (dissolve) into solution (as ions)	**1**
	because zinc is more reactive than copper **AND** silver is less reactive than copper	**1**

Question	Answer	Marks
5(a)	both colours referred to correctly as observations in both parts of the answer	**1**
	(if sulfuric acid is added to solution **Y**,) equilibrium moves to the right-hand side	**1**
	because the concentration of acid has increased	**1**
	(if sodium hydroxide is added to solution **Y**,) equilibrium moves to the left-hand side	**1**
	because sodium hydroxide reacts with / neutralises sulfuric acid	**1**
5(b)(i)	210 cm^3 **M1** expected volume of hydrogen = 300 cm^3 **M2** 70% of **M1**	**2**
5(b)(ii)	fewer moles / molecules / particles (of gas) on the left-hand side	**1**
5(b)(iii)	endothermic	**1**
5(b)(iv)	increases rate (of reaction)	**1**