Mark scheme – Predicting Chemical Reactions (F)

Question			Answer/Indicative content	Marks	Guidance
1			**B** ✓	1 (AO2.1)	
			Total	**1**	
2			**D** ✓	1(AO 1.1)	<u>**Examiner's Comments**</u> Almost all candidates realised that carbon dioxide shows the largest percentage change. Some went for the largest percentage **increase** rather than percentage change, choosing option A.
			Total	**1**	
3			**D** ✓	1(AO 1.1)	<u>**Examiner's Comments**</u> Most candidates realised that cobalt is a transition metal, with a sizeable minority opting for carbon
			Total	**1**	
4			**C** ✓	1(AO 1.2)	<u>**Examiner's Comments**</u> Most candidates realised that the gas was hydrogen, with carbon dioxide being the most common alternative.
			Total	**1**	
5	a	i	Iodine + sodium bromide ✓	1 (AO2.1)	**Both required for the mark** **ALLOW** answers in either order
		ii	Bromine is more reactive than iodine / ORA ✓	1 (AO1.1)	**ALLOW i**odine cannot displace bromine
		iii	$Cl_2 + 2NaI \rightarrow 2NaCl + I_2$ Formulae ✓ Balancing ✓	2 (AO1.1) (AO2.1)	**ALLOW** any correct multiple, including fractions **DO NOT ALLOW** and / & instead of '+' balancing mark is dependent on the correct formulae but **ALLOW** 1 mark for a balanced equation with a minor error in subscripts / formulae eg $CL_2 + 2NAI \rightarrow 2NaCl + I2$
	b	i	Idea of preventing potassium reacting with air or oxygen / idea of preventing potassium reacting with water ✓	1 (AO1.1)	**ALLOW** potassium reacts with air or oxygen / potassium reacts with water
		ii	(Sodium and potassium) both have 1 electron in their outer shell / both have the	1 (AO1.1)	**ALLOW** both form 1+ ions

			same number of electrons in their outer shell ✓		
			Total	**6**	
6		i	Green ✓	1 (AO3.2b)	
		ii	Magnesium most reactive Zinc Iron Copper least reactive correct order – 2 marks magnesium as most reactive and copper as least – 1 mark	2 (AO3.2b)	
		iii	$Mg + CuSO_4 \rightarrow MgSO_4 + Cu$ ✓	1 (AO2.2)	**ALLOW** any correct multiple, including fractions **DO NOT ALLOW** and / & instead of '+' **ALLOW** a minor error in subscripts / formulae
			Total	**4**	
7			Fluorine – **gas** ✓ Astatine – Radius in the range **0.148 - 0.210** ✓	2 (AO1.1) (AO3.2a)	
			Total	**2**	
8	a		$Mg + 2HCl \rightarrow MgCl_2 + H_2$ Formulae ✓ Balancing ✓	2(AO 2.2)	**ALLOW** any correct multiple, including fractions **DO NOT ALLOW** 'and/&' instead of '+' balancing mark is dependent on the correct formulae but **ALLOW** 1 mark for a balanced equation with a minor error in subscripts / formulae eg $Mg + 2HCL \rightarrow Mgcl_2 + H_2$ **<u>Examiner's Comments</u>** The task of writing an equation has two main components: writing the correct formulae, most of which were given, and then doing the balancing. In this case, higher ability candidates showed mastery of the formulae and went on to gain both marks. Most other candidates were uncertain of the formulae of hydrogen gas and used 'H' or '2H'. Some did not see the formula of the hydrochloric acid in the stem and wrote HCl_2.

	b		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Analyses the results (in relation to <u>both</u> volume of acid & mass of magnesium) to show that they do not support the prediction. **AND** explains the results using the reacting particle model. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Analyses the results (in relation to <u>both</u> volume of acid & mass of magnesium) to show that they do not support the prediction OR sees that (both) predictions are incorrect and uses the data to show that only concentration affects reaction time **AND** explains the results using the reacting particle mode Uses the reacting particle model in terms of more collisions rather than frequency of collisions. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Analyses the results to show one of the predictions to be incorrect **OR** Uses the reacting particle model in terms of more collisions rather than frequency of collisions. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	6(AO 3×2.2 3×2.2b)	**AO3.2b Analyse information and ideas to draw conclusions.** • results show as volume decreases reaction time does not change so reaction time does not change • results show that as mass of magnesium increases reaction time does not change • reaction in experiment 3 is faster / has a shorter reaction time, than experiment 2 **AO2.2 Apply knowledge and understanding of scientific enquiry, techniques and procedures.** • concentration is higher in experiment 3 • acid particles are more crowded in experiment 3 / acid particles are closer together / more acid particles per unit volume / more acid particles per cm^3 / more acid particles in the same space • more (successful) collisions per second / collisions more often / increased collision frequency / more chance of a collision **IGNORE** references to 'faster' collisions **<u>Examiner's Comments</u>** While candidates often had trouble in describing what the table showed, many of them showed a clear intuitive understanding and pointed out that it was only changes in concentration that produced an effect. The higher ability candidates responded to both the command prompts and interpreted the table and also included ideas about the reacting particle model. A very large number of candidates did not respond to this second prompt, which limited the number of marks available to them.
	c		**Any two from:** **Cooling the acid:**	3(AO 3 × 2.2)	**ALLOW** particles don't move as much **ALLOW** 'less (unspecified) kinetic energy' **IGNORE** 'less energy' unless linked to particles

			• idea that acid particles move slower / particles have less energy ✓ • idea of decreased collision frequency ✓ • idea of less successful collisions / collisions are less energetic ✓ **AND** **Predicted reaction time** – Any time more than 30s ✓		**Examiner's Comments** Higher ability candidates realised that the particles would move slower or have less energy and suggested a suitable reaction time. Occasionally they even went on to discuss collision frequency or the idea of successful collisions and so scored all three marks. Others showed much confusion over 'rate of reaction' and 'time for reaction'. Many said that when the rate is less the time is less, to the point where examiners could not give credit for statements such as 'the reaction is slower' because there was so much evidence of misunderstanding in that area. A significant number of candidates were able to explain what happens when temperature increases but had some difficulty in reversing their argument to explain what happens if temperature falls. Answers such as 'Less chance of more frequent successful collisions' and 'Fewer frequent successful collisions' were common. These candidates were still able to gain full marks, but centres should be aware of this as a potential problem.
			Total	**11**	
9	a	i	Molecular formula: At_2 (1) Atomic radius: 148 – 168 (1)	2	**DO NOT ALLOW** AT_2 / At2 **ALLOW** any range of numbers provided it is completely within the range given for the answer
		ii	Makes iodine and sodium bromide (1)	1	
		iii	Bromine is more reactive than iodine (1)	1	**ALLOW** ORA
	b	i	Same number of electrons in outer shell / all have 7 electrons in outer shell (1)	1	**ALLOW** outer electrons or valence electrons rather than electrons in the outer shell **ALLOW** valence shell rather than outer shell **DO NOT ALLOW** the wrong number of electrons in the outer shell
		ii	$2Na + Br_2 \rightarrow 2NaBr$ Correct formulae of reactants and products (1) Balancing – depend on correct formulae (1)	2	**ALLOW** any correct multiple of the equation including fractions **ALLOW** = or ⇌ instead of → **DO NOT ALLOW** and or & instead of +

					ALLOW one mark for correct balanced equation with minor errors of case and subscript e.g. 2NA + Br2 → 2NaBr
		iii	KAt (1)	1	
			Total	**8**	
10			B	1	
			Total	**1**	
11			D	1	
			Total	**1**	