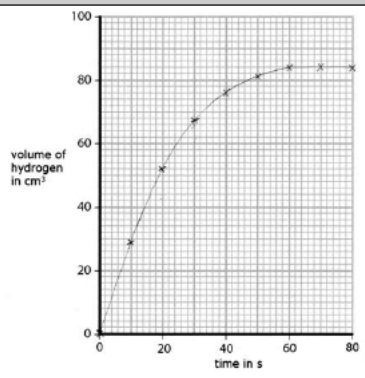
PPQu – Rates of Reaction MARK SCHEME

Warm up questions:

Qu	Answer	Marks
1	- Particles have more kinetic energy - Therefore move faster - There are more frequent successful collisions - Therefore rate increases	1 1 1 1
2	- Particles are closer together OR there are more particles in the same volume - Therefore there are more frequent successful collisions - Therefore rate increases	1 1 1 1
3	- There are more frequent successful collisions - Therefore rate increases	1 1
4	- A substance that increases the rate of a chemical reaction - Without being used up itself	1 1
5	- Provides an alternative pathway - With a lower activation energy	1 1

Past Paper questions:

Q1.

Question number	Answer	Notes	Marks
a (i)		all points plotted correctly to + or – half a square	1
(ii)		curve of best fit drawn for points plotted	1

Question number	Answer	Notes	Marks
b i	**M1** curve Y starting at origin **and** below original curve **M2** levelling off at 42 cm^3 to + or – half a square		**2**
ii	**M1** curve Z starting at origin **and** above original curve **M2** levelling off at 84 cm^3 to + or – half a square	**ACCEPT** curves unlabelled If curves labelled incorrectly then deduct 1 mark	**2**
c	Any one from: **M1** some gas escapes before the bung is replaced/ before the syringe is connected **M2** the magnesium is impure/ the magnesium ribbon has an oxide coating	**IGNORE** gas escapes unqualified **IGNORE** magnesium didn't fully react /reaction didn't go to completion **ALLOW** some gas dissolves in the solution/acid/water	**1**

Question number	Answer	Notes	Marks
d	An explanation that links together the following two points: **M1** the acid is in excess **M2** therefore a precise/ an accurate measurement of the volume is not required	 **M2** dep on **M1**	**2**
e	An explanation that links the following points: **M1** the concentration of the acid/hydrogen ions/H^+ (ions) decreases **M2** therefore there are fewer (successful) collisions (between the hydrogen ions/H^+ ions and the magnesium atoms) **M3** per second/per unit time	 **ALLOW** there are fewer hydrogen ions/H^+ (ions) in the same volume **ALLOW** the surface area of the magnesium decreases less frequent collisions/ slower collision rate scores **M2** and **M3** **M3** dep on **M2** **IGNORE** less chance of collision **MAX 1** if reference to energy of particles changing	**3**

(**Q13 4CH1/1C, June 2019**)

Q2.

Question number	Answer	Notes	Marks
(a)	prevents liquid / acid splashing out		1 Exp
(b) (i)	**M1** (1.8 ÷ 20 =) 0.090	**IGNORE** number of significant figures **ACCEPT** -0.090	2 Exp
	M2 grams per second	**ALLOW** grams/second or g/s or gs^{-1}	
(ii)	**M1** all points plotted ± half a square **M2** curve of best fit	**Max (1)** if first point not plotted / included in curve	2 Exp
(iii)	**M1** concentration (of hydrochloric acid) decreases / smaller amount/surface area of calcium carbonate	**ALLOW** fewer particles **ALLOW** any idea that either reactant is being used up (but not run out)	2 Exp
	M2 fewer collisions per unit time / less frequent collisions	**IGNORE** less chance of a collision	
(iv)	Any one from: **M1** the calcium carbonate has run out **M2** no more carbon dioxide is given off **M3** the reaction has finished	**REJECT** hydrochloric acid has run out	1 Grad
(c) (i)	Any two from: **M1** concentration of hydrochloric acid **M2** volume of hydrochloric acid **M3** temperature	**ALLOW** amount of hydrochloric acid	2 Grad
(ii)	**M1** (powder has a) greater surface area **M2** therefore there are more collisions (per unit time)		2 Exp
(iii)	Any one from: **M1** the graph would be steeper **M2** the line would get to 146 g / flatten off / finish after a shorter time	**ALLOW** higher gradient / line decreases faster **REJECT** any reference to more carbon dioxide being produced.	1 Exp
	Total for question		13

(**Q05 4SS0/1C, Nov 2020**)

Q3.

Question number	Answer	Notes	Marks
a (i)	An explanation linking the following two points **M1** to stop acid (spray) leaving the flask OWTTE **M2** as (without cotton wool) mass loss would be too large OWTTE	**ALLOW** so that only gas can escape (from flask) OWTTE **ALLOW** so the only cause of mass loss is gas (escaping) **REJECT** stops gas escaping **REJECT** references to substances/impurities/gases entering flask **ALLOW** as with cotton wool the mass does not decrease by more than it should OWTTE	2
a (ii)	B gas is given off A is incorrect as particles moving does not result in mass loss C is incorrect as heat energy being produced does not result in mass loss D is incorrect as marble chips dissolving does not result in mass loss		1
b	$CaCO_3$ (s) + 2HCl (aq) → $CaCl_2$ (aq) + H_2O (l) + CO_2 (g) All 5 correct scores 2 4, 3 correct scores 1	**ALLOW** upper case	2

Question number	Answer	Notes	Marks
c	**M1** curve steeper than the original curve **M2** levels off at the same mass loss/place as original curve		2
d (i)	An explanation linking the following three points **M1** (rate) increases **M2** more particles in the same volume **M3** more (successful) collisions per unit time / more frequent (successful) collisions	**ALLOW** particles closer together If reference to particles move faster/have more energy **MAX 1** **IGNORE** references to increased chance/probability of collisions	3
(ii)	An explanation linking the following three points **M1** (rate) increases **M2** (mean kinetic) energy of particles increases **M3** more successful collisions per unit time / more frequent successful collisions OWTTE	**ALLOW** particles move faster **ALLOW** more particles have energy ≥ activation energy **ALLOW** reference to more frequent collisions between particles having ≥ activation energy	3 **Total 13**

(**Q05 4CH1/1CR, June 2019**)