MARK SCHEME

GCSE
CHEMISTRY
AQA - COMBINED SCIENCE

C6 - TEST 6
RATE OF REACTION
Advanced

Mark schemes

1. (a) $CaCO_3 + \textbf{2}HCl \rightarrow CaCl_2 + \textbf{CO}_2 \textbf{+ H}_2\textbf{O}$

                   one mark for CO_2 and H_2O ***or*** *H_2CO_3*

                   one mark for balancing the equation

                                                        2

     (b)   (i)   linear suitable scale for y axis

                   ± one small square

                                                        1

                 accurate plots

                   deduct one mark for each error plot

                                                        1

                 smooth curve through the points **or** a line of best fit

                   this mark requires a neat smooth curve

                                                       1

          (ii)   curve becomes almost horizontal at **or** above 268.5

                   do not credit a straight line reaching 268.5 at 11 mins

                   accept a plot at 268.6

                                                      1

         (iii)   steeper initial part to curve

                                                       1

                 becoming nearly horizontal between 268.6 and 268.4 g

                                                      1

                                                           [8]

2. (a)   fewer product molecules than reactant molecules (owtte) **or**

                   accept forward reaction produces fewer molecules

                   accept left hand side for reactants and right hand side for products

       3 reactant molecules and 1 product
     or 3 volumes of gas becomes 1 volume of gas

                   accept high pressure favours the side with fewer molecules

                   ignore references to reaction rate

                                                      1

(b)   any **three** from:

- low temperature gives best yield

    *accept <u>add</u> heat as increased temperature **or** 'less' as poor yield*

    or high temperature gives poor yield

- because the reaction is exothermic

    accept reverse argument if clearly expressed

- reaction too slow at low temperature
  or reaction faster at high temperature

    accept <u>add</u> heat and reaction goes faster

- temperature used gives a reasonable yield
  at a fast rate / compromise explained

    allow get less product but it takes less time
    *for **2** marks*

                                                                                          3

                                                                                                    [4]

3.   (a)   (i)   yield increases

                    two marks are linked

                                                                                          1

                    because more (gaseous) reactant molecules / particles than (gaseous)
                    product molecules / particles

                        accept 7 → 4 moles or volumes
                        ignore more reactants
                        accept fewer particles on the right

                                                                                          1

            (ii)   increased (rate) / faster / speeds up etc

                    two marks are linked

                                                                                          1

                    more collisions **or** increased concentration **or** particles closer together

                        greater chance of more successful collisions

                                                                                          1

    (b)   heat / high temperatures

                *do **not** accept burn it ignore cracking / catalyst*

                                                                                          1

                                                                                                    [5]

4.   (a)   the forward and backward reactions occur

                allow reversible

                                                                                          1

            at (exactly) the same rate

                                                                                          1

in a closed system

> *allow therefore the concentrations / amounts of the reactants and products <u>remain</u> the same*

1

(b) (i) increasing the temperature would <u>lower</u> the yield of ethanol **or** the (position of) equilibrium moves to the left

> *if student has stated that increasing the temperature increases the yield then award **0** marks*

1

since the backwards reaction is endothermic **or** the forward reaction is exothermic

1

(ii) increasing the pressure would <u>increase</u> the yield of ethanol **or** the (position of) equilibrium moves to the right

> *if student has stated that increasing the pressure decreases the yield then award **0** marks*

1

because the position (of equilibrium) moves in the direction of the lower number of moles (of gas)

> *2 (moles / molecules / volumes / particles) on lhs / 1 (mole / molecule / volume / particle) on rhs*

1

(c) (a catalyst) provides an alternative pathway

1

with lower activation energy

or

(a catalyst) lowers the activation energy (1)

so less energy is needed to react **or** more particles react (1)

1

[9]

5. (a) $CaCl_2 + CO_2 + H_2O$

> *products in any order*

1

balancing: **2** (HCl)

> *dependent on correct formulae for products*

1

(b)   value from graph used to show volume increase

                must include a time or volume value

                1

  values from graph used to show the volume increases less rapidly

                must include time interval or volume increment

                1

  volume **or** time stated when graph line levels off

                allow levels off at 60 (cm^3) **or** *28 to 30 s*
                allow descriptions in terms of rate of reaction

                1

                values must be approximately correct

(c)   draw tangent at <u>15 s</u>

                allow draw a straight line on the curve at <u>15 s</u>

                1

  calculate gradient

                allow correct description of gradient calculation
                ignore calculations if given

                1

(d)   centimetres cubed per second

                allow cm^3/s **or** *$cm^3\ s^{-1}$ (all lower case)*
                allow mixture of abbreviations and words, e.g.
                centimetres cubed/s

                *do **not** accept non-SI abbreviations (e.g. sec for s)*

                1

(e)   (rate) increases as chips get smaller

                allow converse

                1

(f)   same amount of acid
  or
  same number of moles of acid

                allow same volume of acid
                allow same concentration of acid
                allow same mass of $CaCO_3$ / marble chips
                allow one reactant is the limiting factor

                1

(g)   (surface area of each face = 2 × 2 =) 4

                1

  (6 × 4 =) 24 (cm^2)

                allow 6 × student's value from step 1

                1

                *an answer of 24 (cm^2) scores **2** marks*

(h)   small(er) chips have large(r) surface area (for the same volume)

   allow converse

      1

so more frequent collisions

   allow more chance of collisions

   allow more likely to collide

   *do **not** accept reference to speed of particles or energy of collisions*

   ignore more collisions

   ignore more successful collisions

      1

(i)   (sloping part is less steep because) reaction is slower

      1

due to less frequent collisions

   *do **not** accept reference to speed of particles or energy of collisions*

   ignore fewer collisions

      1

fewer acid particles (in same volume)

   ignore weaker acid

      1

or
(sloping part is less steep because) reaction is slower (1)

there are fewer acid particles (in same volume) (1)

(graph levels off lower) so less gas is produced (1)

allow converse for more concentrated acid

      [17]