CONSOLIDATION ANSWERS   D

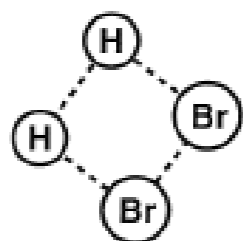|			KU	PS
1.	(a)	From pink to colourless	1	-
	(b)	200 seconds	-	1
	(c)	The colour change will be slow. **OR** Colour change too gradual to give sharp end-point.	-	1
2.	(a) (i)	An unstable arrangement of atoms (½) with reactant bonds half broken and product bonds half formed. (½)	1	-

(ii)

|			KU	PS
			1	-
	(b) (i)	More collisions have greater energy (½) and so are more likely to be successful in forming products. (½) **OR** More collisions have **KE** greater than E_a (½) so more collisions will form products. (½)	1	-
	(ii)	Temperature is a measure of the average kinetic energy of the molecules. **OR** The greater the temperature, the greater the average kinetic energy of the molecules.	1	-
3.	(a)	Half the rate	1	-
	(b)	[Line **B** rising below line **A** (½) and levelling out at half the height of **A** (½)]	-	1
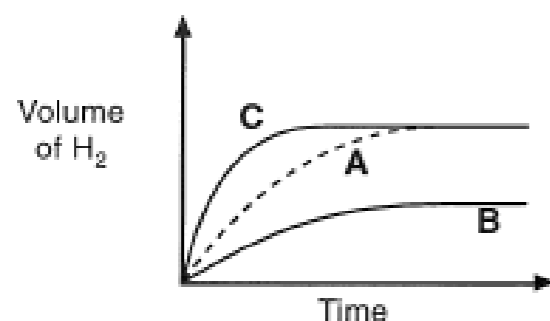
			KU	PS
	(c)	[Line **C** rising steeper than line **A** (½) and levelling out at the same height as **A** (½)]	-	1
		TOTALS	6	4

Higher Chemistry
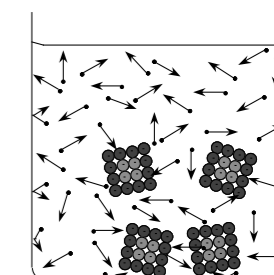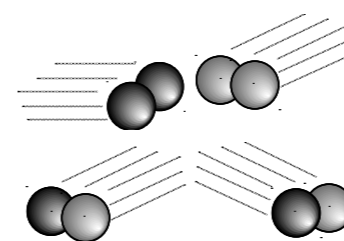
Topic 2:
Reaction Rates

Answer Book

2.1	A	B	C	D
1	■			
2				■
3		■		
4			■	
5		■		
6				■
7	■			
8				■

2.2	A	B	C	D
1		■		
2				■
3		■		
4			■	
5	■			
6			■	
7		■		
8			■	

2.3	A	B	C	D
1	■			
2			■	
3		■		
4	■			
5		■		
6			■	
7	■			
8				■

2.4	A	B	C	D
1				■
2				■
3			■	
4		■		
5	■			
6			■	
7			■	
8		■		

2.5	A	B	C	D
1			■	
2		■		
3				■
4			■	
5				■
6		■		
7	■			
8				■

2.6	A	B	C	D
1	■			
2	■			
3	■			
4			■	
5				■
6			■	
7		■		
8		■		

2.7	A	B	C	D
1				■
2		■		
3			■	
4	■			
5		■		
6		■		
7				■
8				■

HOME PRACTICE ANSWERS   2.1

1. (a) Increase **OR** speed up   (1)

   (b) Decrease **OR** slow down   (1)

2. (a) Reactions (collisions) only happen at the surface of solids. (½)

   Powdered solids have a larger surface area (½) therefore more
   zinc atoms are exposed to collisions with hydrogen ions (½)

   Chemical change depends on particles colliding, so more
   collisions gives a faster rate of reaction. (½)   (2)

   (b) (i)   There will be **more** collisions per second.   (1)

        (ii) Particles can only react if they **collide**.   (1)

   (c) (i)   They will collide with **higher** energy.   (1)

        (ii) The particles colliding must have **enough** energy otherwise
              the collision will **not** result in a reaction.   (1)

3. (a) Y is faster.   (1)

   (b) There are more acid particles (or hydrogen ions) (½)
        so there will be more collisions. (½)   (1)

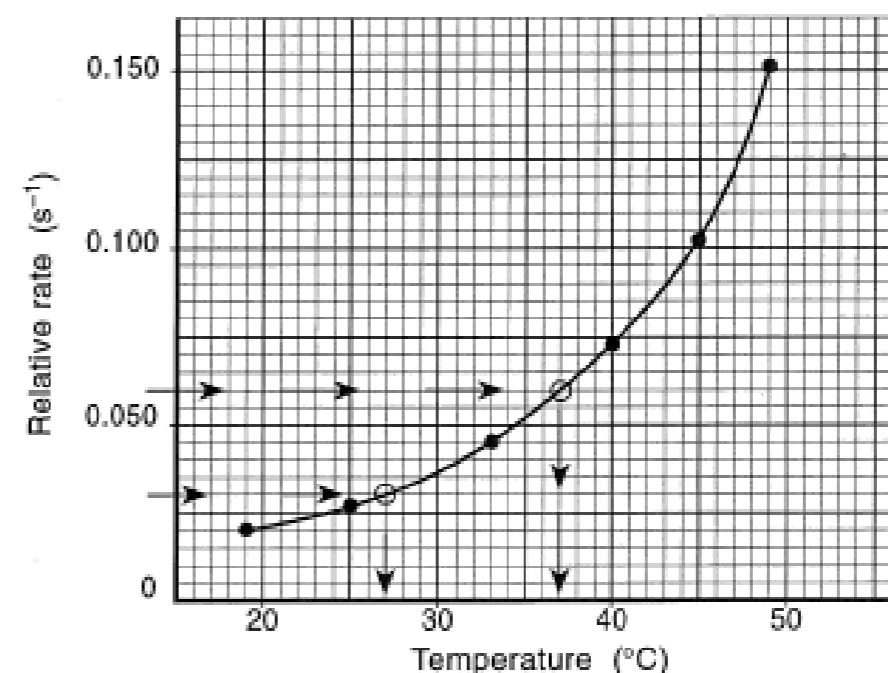   TOTAL (10)

Learn from any mistakes by checking over all wrong answers.
Ask your teacher about anything you still do not understand.

CONSOLIDATION ANSWERS   C

		KU	PS

1. (a)

[Axes labelled (½); units stated (½); points plotted (½);
best fit **curved** line (½)]

[Arrows showing derivation of temperature values are
not required.]   -   2

   (b) 10 °C [Accept 8 °C to 12 °C]   -   1

2. (a) Powder has a greater surface area (½) and therefore there
        is room for more collisions to occur.   1   -

   (b) No effect   -   1

3. (a) Starch (solution)   1   -

   (b) (The time) from the mixing of the solutions to the first
        appearance of a blue-black colour.   1   -
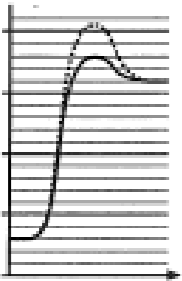
   (c) By calculating $\frac{1}{t}$ 1   -

4.

Industrial process	Industrial product	Catalyst		
Haber (process) (½)	ammonia	iron (½)		
Ostwald process	nitric acid (½)	platinum (½)	2	-

                                                      TOTALS 6   4

CONSOLIDATION ANSWERS   B

			KU	PS
1.	(a)	The catalyst surface becomes coated in lead	1	-
	(b)	Heterogeneous	1	-

2. (a) $-470 - (-620) = 150 \, kJ \, mol^{-1}$

   $[-(\frac{1}{2})$ if no, or incorrect, unit] | - | 1 |

   (b)

   [Labelling of axes and scale not required]

   [Dotted line must **match** solid line at start and finish, but should have **higher** peak in between] | - | 1 |

   (c) Any **one** from:
   – invertase in the breakdown of sugars
   – formation of yoghurt
   – photosynthesis
   – wine making
   – fermentation
   – respiration
   – digestion
   – brewing
   [**OR** other suitable] | 1 | - |

3. (a) Av rate $= \dfrac{\text{change in vol}}{\text{time interval}}$ $(\frac{1}{2})$

   $= \dfrac{40}{20}$ $(\frac{1}{2})$

   $= 2 \, cm^3 \, min^{-1}$ (1)
   $[-(\frac{1}{2})$ if no, or incorrect, unit] | 2 | - |

   (b) Av rate $= \dfrac{88 - 84}{100 - 80}$ $(\frac{1}{2})$

   $= 0.2 \, cm^3 \, min^{-1}$ $(\frac{1}{2})$ [Unit not essential] | - | 1 |

   (c) As the reaction proceeds the acid concentration decreases
   OR the quantity (surface area) of $CaCO_3$ decreases. | 1 | - |

   (d) One of the reactants has been completely used up. | - | 1 |

| | | | TOTALS | 6 | 4 |

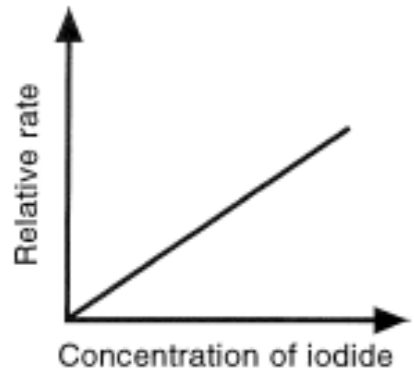# HOME PRACTICE ANSWERS   2.2

1. (a) nitrogen dioxide → nitrogen + oxygen   (1)

   carbon monoxide + oxygen → carbon dioxide   (1)   (2)

   (b) Lead (and its compounds) will poison the catalyst.   (1)

2. (a) ... adsorption $(\frac{1}{2})$

   (b) ... weak $(\frac{1}{2})$

   (c) ... weakens $(\frac{1}{2})$

   (d) ... more $(\frac{1}{2})$

   (e) ... break $(\frac{1}{2})$

   (f) ... more $(\frac{1}{2})$ (3)

3. Enzymes   (1)

4.

	Reaction	Catalyst		Type of catalysis	
(a)	Haber Process	(i) iron	$(\frac{1}{2})$	(ii) heterogeneous	$(\frac{1}{2})$
(b)	Ostwald Process	(i) platinum	$(\frac{1}{2})$	(ii) heterogeneous	$(\frac{1}{2})$
(c)	Fermentation	(i) enzymes **OR** yeast	$(\frac{1}{2})$	(ii) homogeneous	$(\frac{1}{2})$

TOTAL (10)

Learn from any mistakes by checking over all wrong answers.
Ask your teacher about anything you still do not understand.

HOME PRACTICE ANSWERS 2.3

1. (a) Starch solution (1)

   (b) (Timing until) the appearance of a blue/black colour (1)

   (c) (i) $\dfrac{1}{\text{time}}$ OR $\dfrac{1}{t}$ (1)

   (ii) Because the amount of thiosulphate solution in each experiment is the same. (1)

2. (a) By using different volumes of the given potassium iodide solution made up to the same total volume with water. (1)

   (b) Increases (1)

   (c)

   Axes correctly labelled $(^1/_2)$ + $(^1/_2)$

   Straight line drawn through origin (1) (2)

   (d) 0.8 M is 4 times as concentrated as 0.2 M (1)

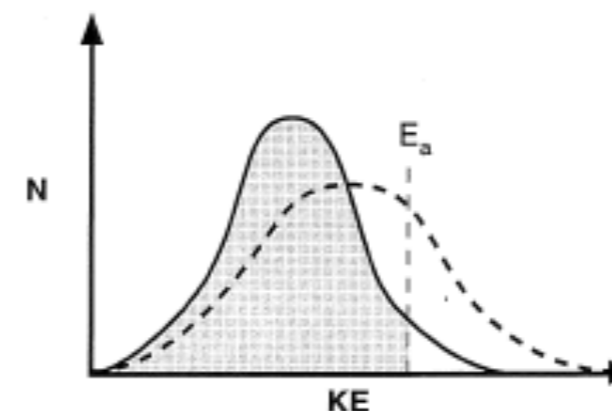   So relative rate = 4 x 0.15 = 0.6 min^{-1} (1) (2)

TOTAL (10)

**Learn from any mistakes by checking over all wrong answers.
Ask your teacher about anything you still do not understand.**

CONSOLIDATION ANSWERS A

		KU	PS
1.	Reaction can only occur when an acid ion collides with a magnesium atom $(^1/_2)$ so having more acid ions present increases the frequency of these collisions. $(^1/_2)$	1	-

2.

		KU	PS
(a)	[Shaded area to **left** of E_a]	-	1
(b)	[Dotted graph lower $(^1/_2)$ and spread more to right $(^1/_2)$]	-	1
(c)	A catalyst lowers the value of E_a $(^1/_2)$ and so more collisions have KE great enough for reaction. $(^1/_2)$	1	-
3. (a)	The carbon is burned off.	1	-
(b)	Regeneration	1	-
4. (a)	0.10 0.20 0.29 0.40 min^{-1} [$-(^1/_2)$ per error in value, $-(^1/_2)$ if unit wrong / not stated]	2	-
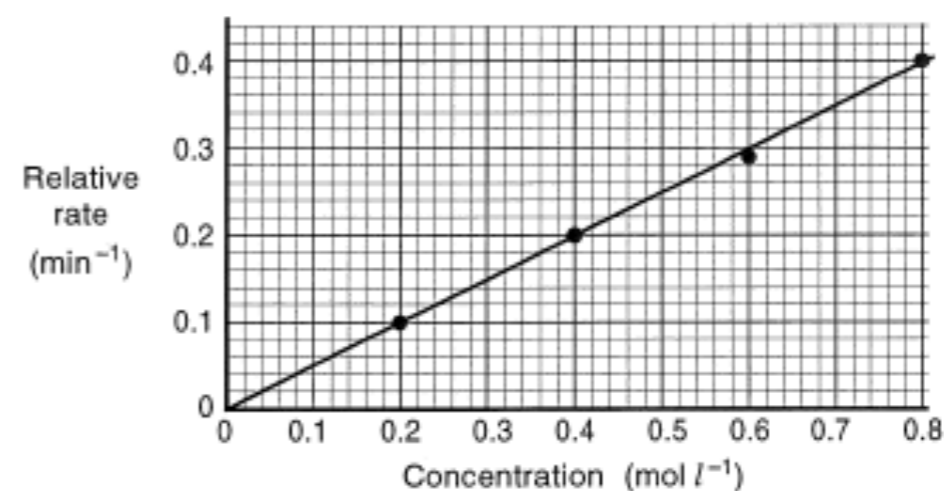
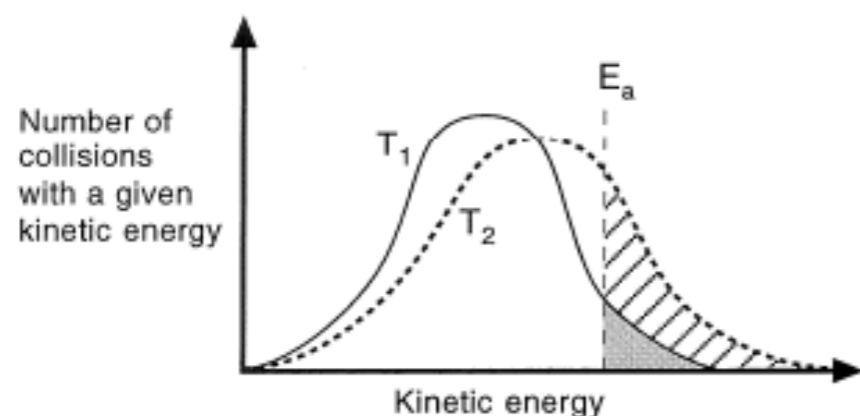|		KU	PS
(b)	[Axes labelled $(^1/_2)$; units stated $(^1/_2)$; points plotted $(^1/_2)$; best fit straight line (through origin) $(^1/_2)$]	-	2
	TOTALS	6	4

HOME PRACTICE ANSWERS   2.7

1. (a) **D**   (1)

     (b) Not enough energy to form an activated complex **OR**
          The molecules simply bounce off each other without reacting.   (1)

     (c) The collisions between molecules with enough energy to
          form an activated complex.   (1)

2. (a) C_2 (1)

     (b)

Peak of dotted line to the right of T_1 **(1)**
[Greater average kinetic energy at higher temperature]

Peak of dotted line lower than for T_1 **(1)**
[Greater spread of energies so fewer have the average energy]   (2)

     (c) Many more molecules collide with energy greater than E_a **(1)**
          so there are many more successful collisions **(1)**   (2)

3.   Light energy is being absorbed by molecules and so increasing
          their energy. **(1)**

          There are therefore more collisions with energy greater than E_a
          resulting in a faster reaction. **(1)**   (2)

TOTAL **(10)**

Learn from any mistakes by checking over all wrong answers.
Ask your teacher about anything you still do not understand.

HOME PRACTICE ANSWERS   2.4

1. (a) (Timing until) the disappearance of the permanganate colour
          OR   The solution changing from purple to colourless   (1)

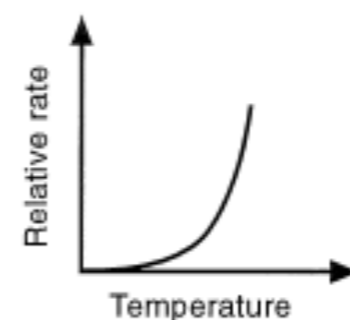   (b) To provide hydrogen ions for the reaction   (1)

     (c) s^{-1} (1)

2. (a) Temperature (of the reaction mixture)   (1)

     (b) Any **three** from:
          – Total volume   **(1)**
          – Volume of permanganate   **(1)**
          – Volume of oxalic acid **(1)**
          – Volume of sulphuric acid **(1)**
          – Concentration of permanganate   **(1)**
          – Concentration of oxalic acid   **(1)**
          – Concentration of sulphuric acid   **(1)**   [Maximum 3]   (3)

     (c)

Axes labelled   **(½) + (½)**

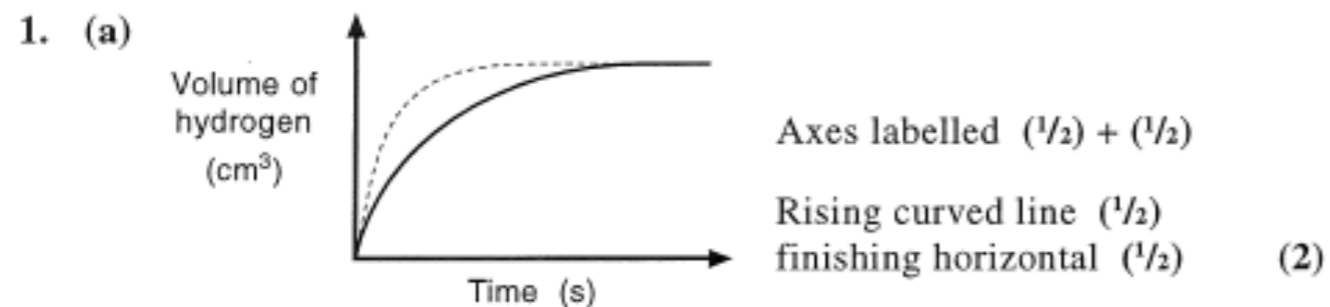Curved line sloping upward **(1)**   (2)

     (d) Doubles the rate (approximately)   (1)

TOTAL **(10)**

Learn from any mistakes by checking over all wrong answers.
Ask your teacher about anything you still do not understand.

HOME PRACTICE ANSWERS   2.5

1. (a)

Volume of hydrogen (cm³) vs Time (s)

Axes labelled ($\frac{1}{2}$) + ($\frac{1}{2}$)

Rising curved line ($\frac{1}{2}$)
finishing horizontal ($\frac{1}{2}$)   (2)

(b) Dotted line steeper at start ($\frac{1}{2}$) but finishing at same volume ($\frac{1}{2}$)   (1)
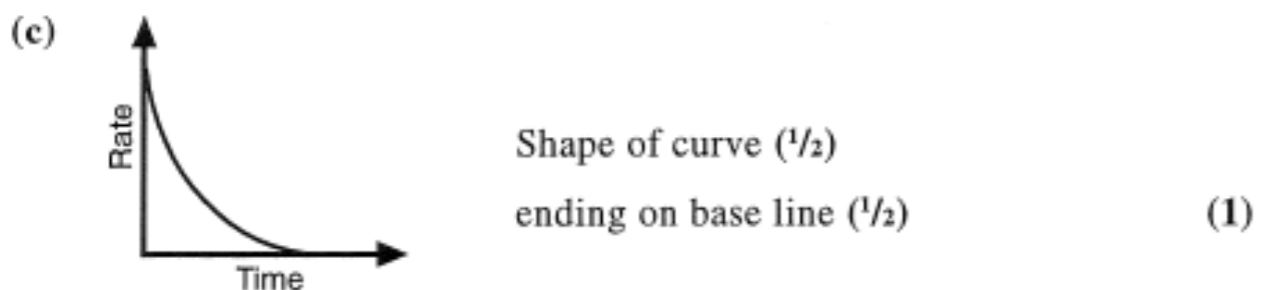
2. Any **two** from:

– Collect and record the total volume of carbon dioxide at suitable time intervals. **(1)**

– Measure and record pH at suitable time intervals. **(1)**

– Measure and record the mass of the container and its contents at suitable time intervals. **(1)**   (2)

3. (a) (i) 140 s (± 10 s)   (1)

(ii) At time zero **OR** at start **OR** in the first second   (1)

(b) $\dfrac{197.4 - 196.6}{110 - 60}$ ($\frac{1}{2}$)
  ($\frac{1}{2}$)

$= 0.016\,\mathrm{g\,s^{-1}}$ **(1)**   [OR $-0.016\,\mathrm{g\,s^{-1}}$]   (2)

(c)

Rate vs Time

Shape of curve ($\frac{1}{2}$)

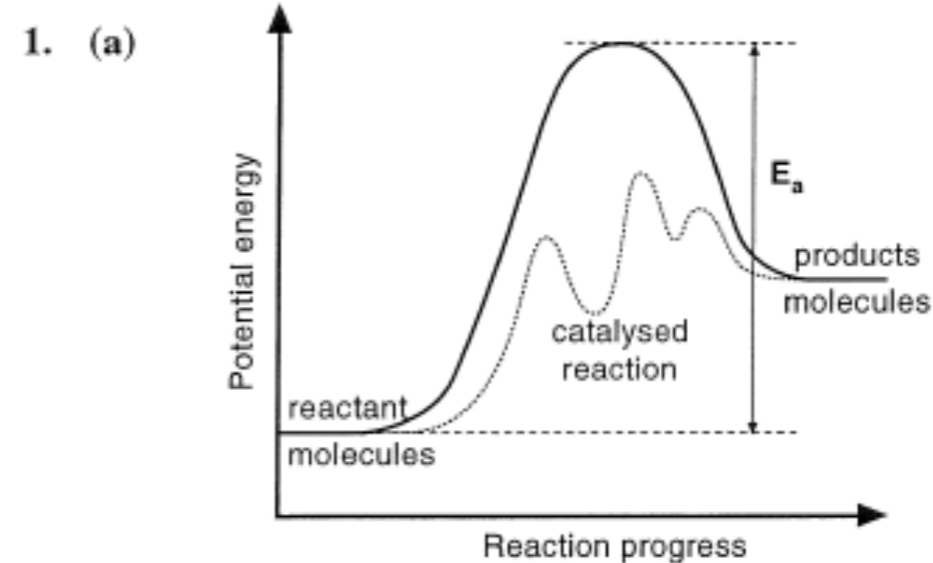ending on base line ($\frac{1}{2}$)   (1)

TOTAL (10)

Learn from any mistakes by checking over all wrong answers.
Ask your teacher about anything you still do not understand.

HOME PRACTICE ANSWERS   2.6

1. (a)

Potential energy vs Reaction progress graph showing reactant molecules, catalysed reaction, products molecules, E_a

Axes labelled ($\frac{1}{2}$) + ($\frac{1}{2}$)

Graph rises then falls ($\frac{1}{2}$)

PEs representing reactant molecules and product molecules labelled on graph ($\frac{1}{2}$)

PE of products higher than PE of reactants **(1)**   (3)

(b) E_a correctly labelled on the diagram   (1)

(c) On graph, start and finish of dotted line same as for black line but pathway in between must be lower.   (1)

2. E_a ($\frac{1}{2}$) in kJ mol^{-1} ($\frac{1}{2}$)   (1)

3. (a)

Diagram: A at top, A and B in middle, B at bottom, connected in diamond   (1)

(b) The reactant bonds are half broken and the product bonds half formed.   (1)

(c) Kinetic energy changes to potential energy.   (1)

(d) Potential energy changes to kinetic energy.   (1)

TOTAL (10)

Learn from any mistakes by checking over all wrong answers.
Ask your teacher about anything you still do not understand.