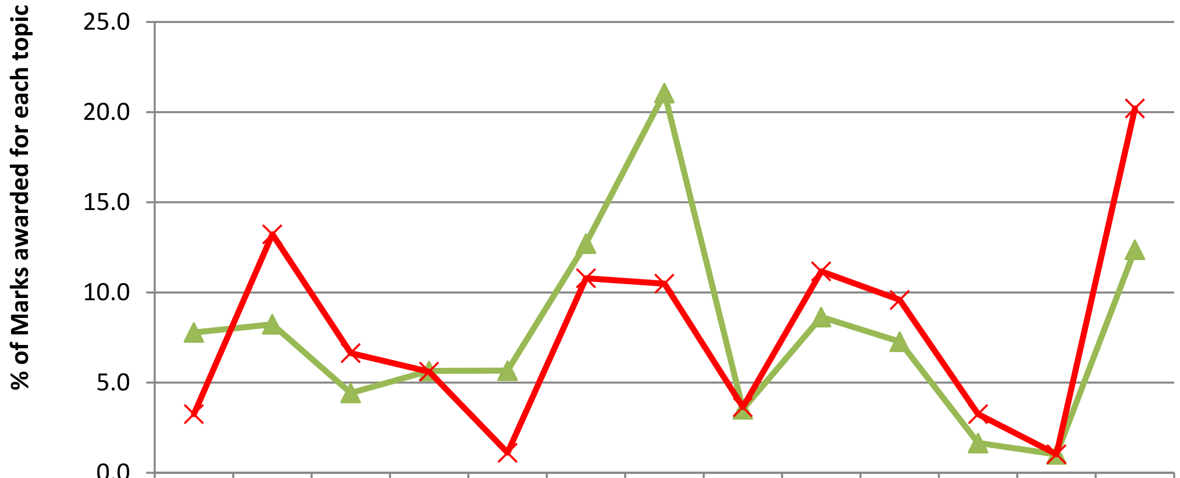
Name

iG Chem 7 EQ P3 15w to 10s 4Students NEW 87marks 18Pgs

PAPERS 1, 3 and 6

Percentage of all WEIGHTED marks awarded for each topic from w2001 to w2015 (green) and % of Paper 3 marks (red)

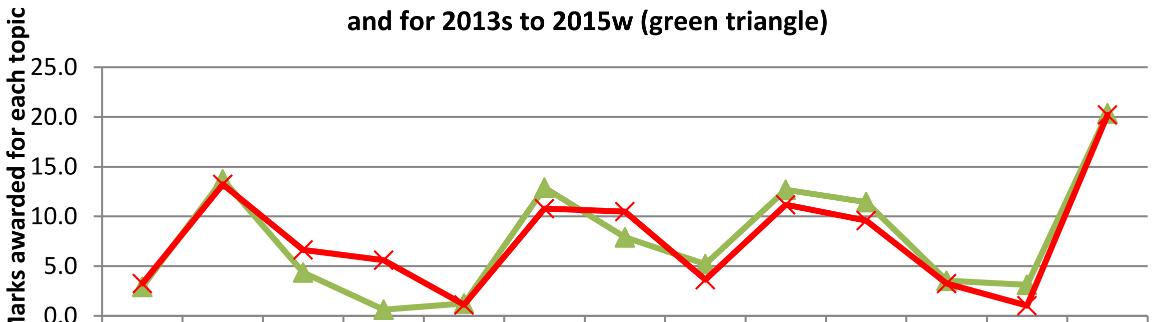


	1	3	4	5	6	7	8	9	10	11	12	13	14
% Marks	7.8	8.2	4.4	5.6	5.7	12.7	21.1	3.5	8.6	7.3	1.7	1.0	12.4
Paper 3 %	3.3	13.2	6.6	5.6	1.1	10.8	10.5	3.6	11.2	9.6	3.3	1.0	20.2

ALL PAPERS Topic Number

PAPER 3

Percentage of all marks awarded for each topic from w2001 to w2015 (red cross) and for 2013s to 2015w (green triangle)



	1	3	4	5	6	7	8	9	10	11	12	13	14
P3 2Yrs	2.9	13.7	4.4	0.6	1.2	12.9	7.9	5.2	12.7	11.4	3.5	3.1	20.4
P3 ALL	3.3	13.2	6.6	5.6	1.1	10.8	10.5	3.6	11.2	9.6	3.3	1.0	20.2

Paper 3 Topic Number

	Total	Chem 1	Chem 3	Chem 4	Chem 5	Chem 6	Chem 7	Chem 8	Chem 9	Chem 10	Chem 11	Chem 12	Chem 13	Chem 14
<u>Total Marks</u>	2320	74	312	155	81	26	256	246	85	296	231	76	24	474
% of Marks	2336	3.2	13.4	6.6	3.5	1.1	11.0	10.5	3.6	12.7	9.9	3.3	1.0	20.3
# of Questions		19	59	39	18	6	47	54	19	58	48	14	5	80
Average marks per Q		**3.9**	**5.3**	**4.0**	**4.5**	**4.3**	**5.4**	**4.6**	**4.5**	**5.1**	**4.8**	**5.4**	**4.8**	**5.9**

	1st Paper	1st P rank	Last Paper	Last P rank	Total # Papers	Marks/ paper	Theor. All Papers	Actual All Marks	Difference	Weight per paper	Weight per mark
Paper 1	**2002s**	**5**	**2012w**	**26**	**22**	**40**	**880**	**869**	**-11**	**30**	**0.75**
Paper 3	**2001w**	**4**	**2015w**	**32**	**29**	**80**	**2320**	**2336**	**16**	**50**	**0.625**
Paper 6	**2001w**	**4**	**2015w**	**32**	**29**	**60**	**1740**	**1890**	**150**	**20**	**0.625**

Topic	**14**	**3**	**10**	**7**	**8**	**11**	**4**	**5**	**9**	**1**	**12**	**6**	**13**
Rank ALL Papers	2	4	5	3	1	6	9	8	11	7	12	10	13
Rank P3: A* Focus	1	2	3	4	5	6	7	8	9	10	10	12	13
All Syllabus Word Count RANK	1	2	5	3	6	4	9	7	10	8	12	11	13

CIE iGCSE Chemistry Syllabus Details

(syllabus code 0620)

The core material is examined in all three exam papers (papers 1,3 and 6) and is intended to assess understanding up to a grade C level. From 2016, the Supplement material is **examined in all three papers**, however, before 2016 papers 1 and 6 did not contain any Supplement material. If the number of marks that can be awarded above a C grade will remain the same, in practice this means that:

1. Paper 3 will contain fewer Supplement marks, so more core marks so will be easier (if you can answer the Paper 3 questions from before 2016 then you will be fine)
2. Papers 1 and 3 will contain Supplement marks, unlike in all papers before 2016, so will assess material they have not done before, so will be harder because of the questions and as there are no previous questions to practice on, will be harder because of the newness.

Material that is new or changed in 2016 is highlighted with BLACK LINES next to it.

7. Chemical reactions	
7.1 Physical and chemical changes **Core** • Identify physical and chemical changes, and understand the differences between them	
7.2 Rate (speed) of reaction **Core** • Describe and explain the effect of concentration, particle size, catalysts (including enzymes) and temperature on the rate of reactions • Describe the application of the above factors to the danger of explosive combustion with fine powders (e.g. flour mills) and gases (e.g. methane in mines) • Demonstrate knowledge and understanding of a practical method for investigating the rate of a reaction involving gas evolution • Interpret data obtained from experiments concerned with rate of reaction Note: Candidates should be encouraged to use the term *rate* rather than *speed*.	**Supplement** • Devise and evaluate a suitable method for investigating the effect of a given variable on the rate of a reaction • Describe and explain the effects of temperature and concentration in terms of collisions between reacting particles (An increase in temperature causes an increase in collision rate **and** more of the colliding molecules have sufficient energy (activation energy) to react whereas an increase in concentration only causes an increase in collision rate.) *cont.*

7.2 Rate (speed) of reaction continued	• Describe and explain the role of light in photochemical reactions and the effect of light on the rate of these reactions (This should be linked to section 14.4.) • Describe the use of silver salts in photography as a process of reduction of silver ions to silver; and photosynthesis as the reaction between carbon dioxide and water in the presence of chlorophyll and sunlight (energy) to produce glucose and oxygen
7.3 Reversible reactions **Core** • Understand that some chemical reactions can be reversed by changing the reaction conditions (Limited to the effects of heat and water on hydrated and anhydrous copper(II) sulfate and cobalt(II) chloride.) (Concept of equilibrium is **not** required.)	**Supplement** • Predict the effect of changing the conditions (concentration, temperature and pressure) on other reversible reactions • Demonstrate knowledge and understanding of the concept of equilibrium
7.4 Redox **Core** • Define *oxidation* and *reduction* in terms of oxygen loss/gain. (Oxidation state limited to its use to name ions, e.g. iron(II), iron(III), copper(II), manganate(VII).)	**Supplement** • Define *redox* in terms of electron transfer • Identify redox reactions by changes in oxidation state and by the colour changes involved when using acidified potassium manganate(VII), and potassium iodide. (Recall of equations involving $KMnO_4$ is **not** required.) • Define *oxidising agent* as a substance which oxidises another substance during a redox reaction. Define *reducing agent* as a substance which reduces another substance during a redox reaction. • Identify oxidising agents and reducing agents from simple equations

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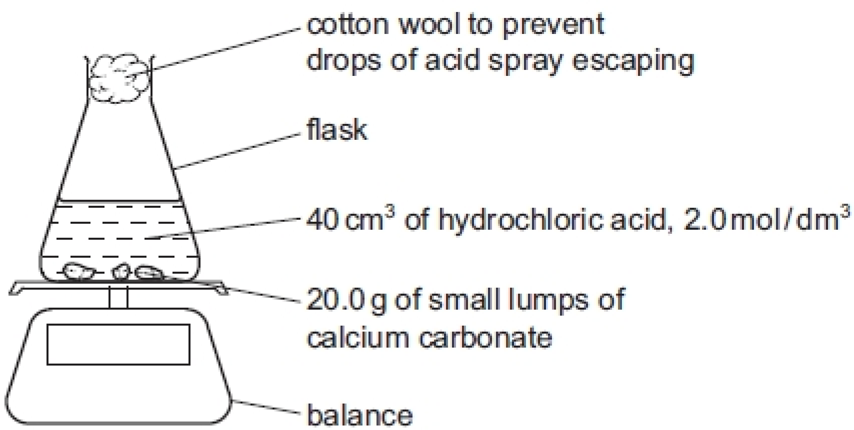
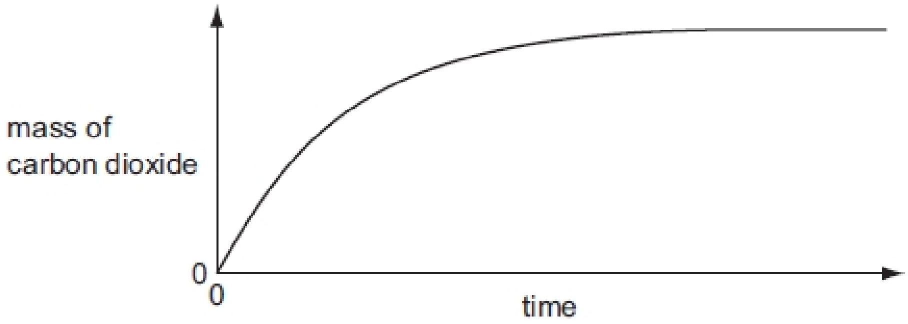
4 20.0 g of small lumps of calcium carbonate and 40 cm^3 of hydrochloric acid, concentration 2.0 mol / dm^3, were placed in a flask on a top pan balance. The mass of the flask and contents was recorded every minute.



The mass of carbon dioxide given off was plotted against time.



$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

In all the experiments mentioned in this question, the calcium carbonate was in excess.

(a) **(i)** Explain how you could determine the mass of carbon dioxide given off in the first five minutes.

.... [1]

(ii) Label the graph **F** where the reaction rate is the fastest, **S** where it is slowing down and **0** where the rate is zero. [2]

(iii) Explain how the shape of the graph shows where the rate is fastest, where it is slowing down and where the rate is zero.

....

....

.... [2]

(b) Sketch on the same graph, the line which would have been obtained if 20.0 g of small lumps of calcium carbonate and 80 cm^3 of hydrochloric acid, concentration 1.0 mol / dm^3, had been used. [2]

(c) Explain in terms of collisions between reacting particles each of the following.

(i) The reaction rate would be slower if 20.0 g of larger lumps of calcium carbonate and 40 cm^3 of hydrochloric acid, concentration 2.0 mol / dm^3, were used.

....

....

.... [2]

(ii) The reaction rate would be faster if the experiment was carried out at a higher temperature.

....

....

.... [2]

3 A small piece of marble, $CaCO_3$, was added to $5.0\,cm^3$ of hydrochloric acid, concentration $1.0\,mol/dm^3$, at 25 °C. The time taken for the reaction to stop was measured. The experiment was repeated using $5.0\,cm^3$ of different solutions of acids. The acid was in excess in all of the experiments.

Typical results are given in the table.

experiment	temperature / °C	acid solution	time / min
1	25	hydrochloric acid $1.0\,mol/dm^3$	3
2	25	hydrochloric acid $0.5\,mol/dm^3$	7
3	25	ethanoic acid $1.0\,mol/dm^3$	10
4	15	hydrochloric acid $1.0\,mol/dm^3$	8

(a) **(i)** Explain why it is important that the pieces of marble are the same size and the same shape.

....

....

.... [2]

(ii) How would you know when the reaction had stopped?

.... [1]

(c) **(i)** Explain why the reaction in experiment 1 is faster than the reaction in experiment 2.

....

.... [1]

(ii) The acids used for experiment 1 and experiment 3 have the same concentration. Explain why experiment 3 is slower than experiment 1.

....

....

.... [2]

(iii) Explain in terms of collisions between reacting particles why experiment 4 is slower than experiment 1.

....

....

.... [3]

5 Carbonyl chloride, $COCl_2$, is widely used in industry to make polymers, dyes and pharmaceuticals.

(a) Carbonyl chloride was first made in 1812 by exposing a mixture of carbon monoxide and chlorine to bright sunlight. This is a photochemical reaction.

$$CO(g) + Cl_2(g) \rightarrow COCl_2(g)$$

(i) Explain the phrase *photochemical reaction*.

....

.... [2]

(ii) Give another example of a photochemical reaction and explain why it is important either to the environment or in industry.

....

....

.... [3]

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5 Carbonyl chloride, $COCl_2$, is widely used in industry to make polymers, dyes and pharmaceuticals.

(b) Carbonyl chloride is now made by the reversible reaction given below.

$$CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$$

The forward reaction is exothermic.
The reaction is catalysed by carbon within a temperature range of 50 to 150 °C.

(i) Predict the effect on the yield of carbonyl chloride of increasing the pressure. Explain your answer.

....

.... [2]

(ii) If the temperature is allowed to increase to above 200 °C, very little carbonyl chloride is formed. Explain why.

....

.... [2]

(iii) Explain why a catalyst is used.

.... [1]

3 The speed (rate) of a chemical reaction depends on a number of factors which include temperature and the presence of a catalyst.

(a) Reaction speed increases as the temperature increases.

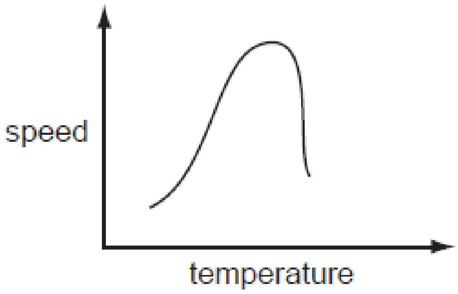
(i) Explain why reaction speed increases with temperature.

....

....

.... [3]

(ii) Reactions involving enzymes do not follow the above pattern.
The following graph shows how the speed of such a reaction varies with temperature.



Suggest an explanation why initially the reaction speed increases then above a certain temperature the speed decreases.

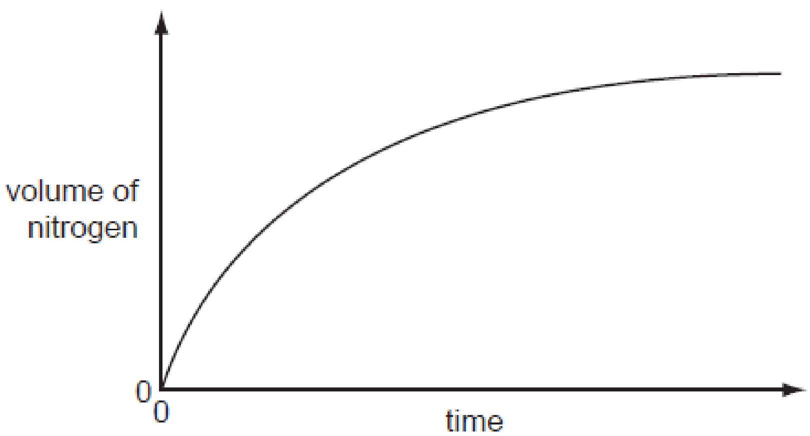
....

.... [2]

(b) An organic compound decomposes to give off nitrogen.

$$C_6H_5N_2Cl(aq) \rightarrow C_6H_5Cl(l) + N_2(g)$$

The speed of this reaction can be determined by measuring the volume of nitrogen formed at regular intervals. Typical results are shown in the graph below.



(i) The reaction is catalysed by copper.
Sketch the graph for the catalysed reaction on the diagram above. [2]

(ii) How does the speed of this reaction vary with time?

.... [1]

(iii) Why does the speed of reaction vary with time?

....

.... [2]

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4 Vanadium is a transition element. It has more than one oxidation state. The element and its compounds are often used as catalysts.

(d) The oxidation states of vanadium in its compounds are V(+5), V(+4), V(+3) and V(+2). The vanadium(III) ion can behave as a reductant or an oxidant.

(i) Indicate on the following equation which reactant is the oxidant.

$$2V^{3+} + Zn \rightarrow 2V^{2+} + Zn^{2+}$$

[1]

(ii) Which change in the following equation is oxidation? Explain your choice.

$$V^{3+} + Fe^{3+} \rightarrow V^{4+} + Fe^{2+}$$

....

.... [2]

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4 Vanadium is a transition element. It has more than one oxidation state. The element and its compounds are often used as catalysts.

(c) Vanadium(V) oxide is used to catalyse the exothermic reaction between sulfur dioxide and oxygen in the Contact Process.

$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

The rate of this reaction can be increased either by using a catalyst or by increasing the temperature. Explain why a catalyst is used and not a higher temperature.

....

....

.... [2]

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(b) Iron has two oxidation states +2 and +3. There are two possible equations for the redox reaction between iron and bromine.

$$Fe + Br_2 \rightarrow Fe^{2+} + 2Br^-$$

$$2Fe + 3Br_2 \rightarrow 2Fe^{3+} + 6Br^-$$

(i) Indicate, on the first equation, the change which is oxidation. Give a reason for your choice.

....

.... [2]

(ii) Which substance in the first equation is the reductant (reducing agent)?

.... [1]

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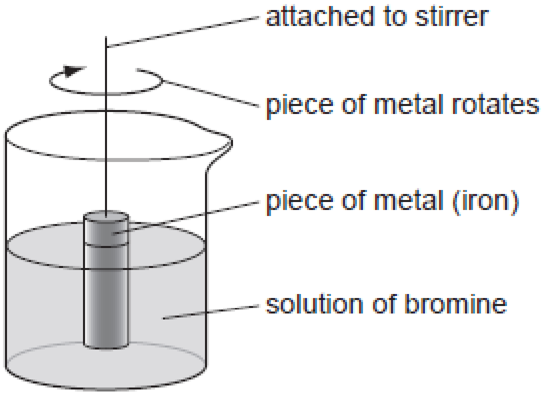
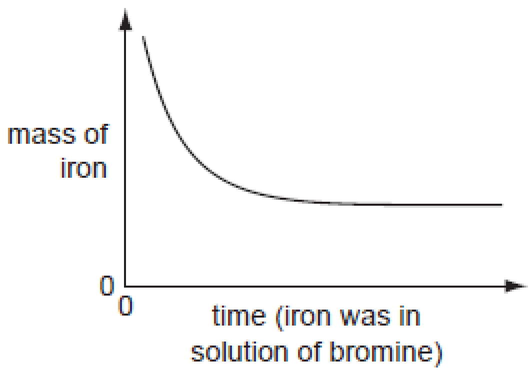
5 The rate of the reaction between iron and aqueous bromine can be investigated using the apparatus shown below.



(a) A piece of iron was weighed and placed in the apparatus. It was removed at regular intervals and the clock was paused. The piece of iron was washed, dried, weighed and replaced. The clock was restarted.
This was continued until the solution was colourless.
The mass of iron was plotted against time. The graph shows the results obtained.



(i) Suggest an explanation for the shape of the graph.

....

....

.... [3]

(ii) Predict the shape of the graph if a similar piece of iron with a much rougher surface had been used.
Explain your answer.

....

.... [2]

(iii) Describe how you could find out if the rate of this reaction depended on the speed of stirring.

....

....

.... [2]

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4 Reversible reactions can come to equilibrium. The following are three examples of types of gaseous equilibria.

$A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$ **reaction 1**

$A_2(g) + 3B_2(g) \rightleftharpoons 2AB_3(g)$ **reaction 2**

$2AB_2(g) \rightleftharpoons 2AB(g) + B_2(g)$ **reaction 3**

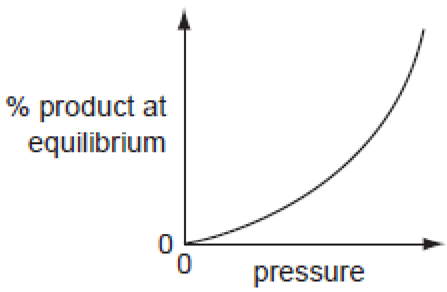
(a) Explain the term *equilibrium*.

....

.... [2]

(b) The following graphs show how the percentage of products of a reversible reaction at equilibrium could vary with pressure.
For each graph, decide whether the percentage of products decreases, increases or stays the same when the pressure is **increased**, then match each graph to one of the above reactions and give a reason for your choice.

(i)



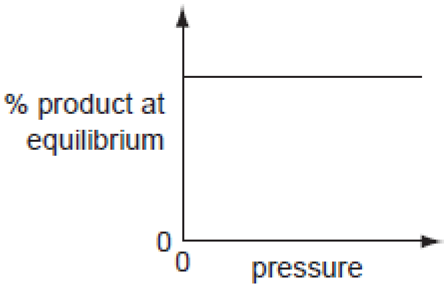
effect on percentage of products ....

reaction ....

reason ....

.... [3]

(ii)



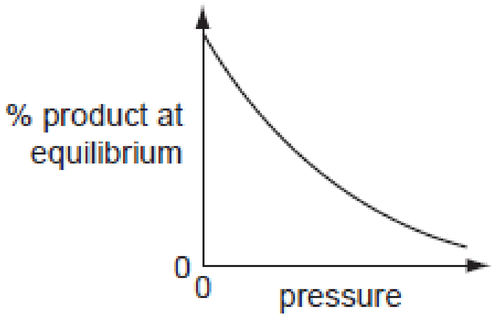
effect on percentage of products ....

reaction ....

reason ....

.... [3]

(iii)



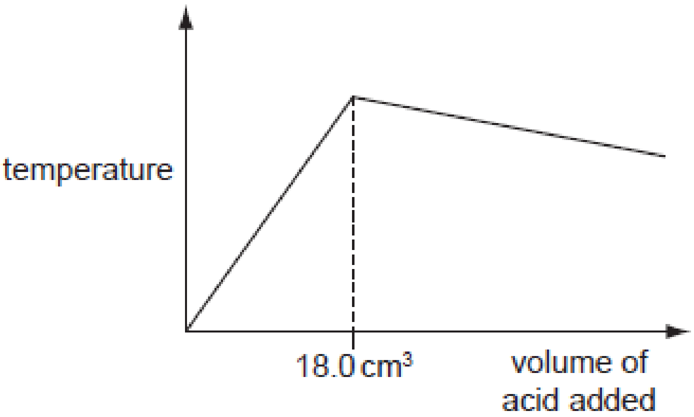
effect on percentage of products ....

reaction ....

reason ....

.... [3]

(d) 20.0 cm^3 of aqueous sodium hydroxide, 2.00 mol / dm^3, was placed in a beaker. The temperature of the alkali was measured and 1.0 cm^3 portions of hydriodic acid were added. After each addition, the temperature of the mixture was measured. Typical results are shown on the graph.



$$NaOH(aq) + HI(aq) \rightarrow NaI(aq) + H_2O(l)$$

(i) Explain why the temperature increases rapidly at first then stops increasing.

....

.... [2]

(ii) Suggest why the temperature drops after the addition of 18.0 cm^3 of acid.

.... [1]

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6 The table below shows the elements in the second period of the Periodic Table and some of their oxidation states in their most common compounds.

element	Li	Be	B	C	N	O	F	Ne
number of outer electrons	1	2	3	4	5	6	7	8
oxidation state	+1	+2	+3	+4	–3	–2	–1	0

(a) (i) What does it mean when the only oxidation state of an element is zero?

....

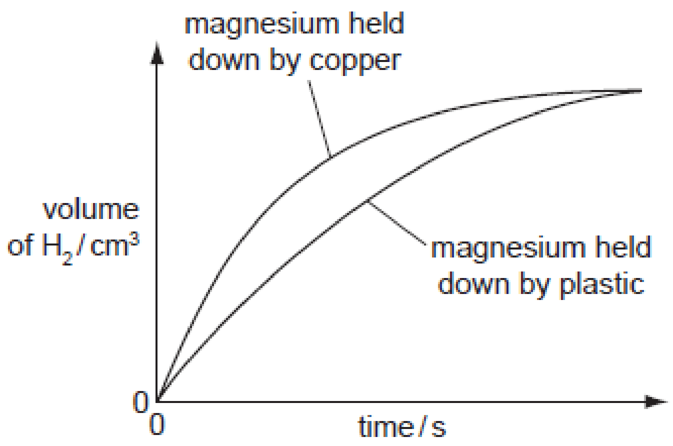
.... [1]

(ii) Explain why some elements have positive oxidation states but others have negative ones.

....

.... [2]

(b) The only difference in the two experiments was the method used to hold down the magnesium. The results are shown below.



(i) In which experiment did the magnesium react faster?

.... [1]

(ii) Suggest a reason why the experiment chosen in **(i)** had the faster rate.

.... [1]

(c) The experiment was repeated using 1.0 mol / dm^3 propanoic acid instead of 1.0 mol / dm^3 hydrochloric acid. Propanoic acid is a weak acid.

(i) How would the graph for propanoic acid **differ** from the graph for hydrochloric acid?

.... [1]

(ii) How would the graph for propanoic acid be the **same** as the graph for hydrochloric acid?

.... [1]

(d) Give **two** factors which would alter the rate of this reaction.
For each factor explain why it alters the rate.

factor ....

explanation ....

....

factor ....

explanation ....

.... [4]

6 Iodine reacts with chlorine to form dark brown iodine monochloride.

$$I_2 + Cl_2 \rightarrow 2ICl$$

This reacts with more chlorine to give yellow iodine trichloride.
There is an equilibrium between these iodine chlorides.

$$\underset{\text{dark brown}}{ICl(l)} + Cl_2(g) \rightleftharpoons \underset{\text{yellow}}{ICl_3(s)}$$

(a) Explain what is meant by *equilibrium*.

....

....

.... [2]

(b) When the equilibrium mixture is heated it becomes a darker brown colour.
Is the reverse reaction endothermic or exothermic? Give a reason for your choice.

....

....

.... [2]

(c) The pressure on the equilibrium mixture is decreased.

(i) How would this affect the position of equilibrium and why?

It would move to the .... [1]

reason ....

.... [1]

(ii) Describe what you would observe.

....

.... [1]

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4 **(a)** **(i)** (mass at t =0) – (mass at t = 5) [1]
NOTE: must have mass at t = 5 not final mass

(ii) fastest at origin
slowing down between origin and flat section gradient = 0
where gradrient = 0
three of above in approximately the correct positions [2]

(iii) 3 correct comments about gradient = [2]
2 correct comments about gradient = [1]
1 correct comment about gradient = [0] [2]

(b) start at origin and smaller gradient [1]
same final mass just approximate rather than exact [1]

(c) **(i)** smaller surface area [1]
lower collision rate [1]

(ii) molecules have more energy [1]
collide more frequently / more molecules have enough energy to react [1]

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3 **(a)** **(i)** pieces have (same) surface area [1]
same amount / mass / quantity / volume / number of moles of carbonate [1]

(ii) no more bubbles / carbon dioxide **or** piece disappears / dissolves [1]

(b) experiment 1 Ca^{2+} + CO_2 + H_2O [1]

(c) **(i)** more concentrated **or** higher concentration (of acid) (in experiment 1) [1]
accept: arguments based on collision theory

(ii) ethanoic acid is a weak acid **or** hydrochloric acid is a strong acid [1]
accept: stronger or weaker

ethanoic acid less ionised / dissociated / lower / smaller concentration of hydrogen ions [1]
accept: less hydrogen ions and vice versa argument but not dissociation of ions

(iii) lower temperature (particles) have less energy [1]
moving more slowly [1]
fewer collisions / lower collision rate [1]
or
lower temperature (particles) have less energy [1]
fewer particles collide [1]
with the necessary energy to react [1]
note: less energy fewer successful collisions gains all 3 marks

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5 **(a)** **(i)** rate of reaction; [1]
influenced by light / only happens in light; [1]
or:
turns light into chemical energy = [2]
accept: light is catalyst = [1]

(ii) reduction of silver halides; [1]
they are reduced to silver / $2AgCl \rightarrow 2Ag + Cl_2$; [1]
appropriate importance given; [1]
or:
photosynthesis;
correct comment about chemistry carbon dioxide to carbohydrates / carbon dioxide to oxygen;
anything sensible e.g. its role in the food chain or decrease greenhouse effect or oxygen for respiration;
or:
chlorination;
making chloroalkanes;
appropriate importance given;

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(b) **(i)** pressure would move position of equilibrium to right / increase yield of $COCl_2$; [1]
increase pressure favours side with less (gas) molecules / smaller volume; [1]

(ii) increase temperature favours endothermic reaction; [1]
so less products / reduce yield; [1]

(iii) keeps rate high / increase rate at lower temperatures; [1]

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3 **(a)** **(i)** any three from:
particles have more energy;
move faster;
collide more frequently;
more successful collisions; [3]
accept: atoms or molecules for particles
not: electrons
not: vibrate more

(ii) reaction faster with temperature increase; [1]
enzymes denatured / destroyed;
not: killed [1]

(b) **(i)** bigger initial gradient; [1]
same final volume of nitrogen; [1]

(ii) decrease / slows down; [1]

(iii) <u>concentration</u> of organic compound decreases; [2]
compound used up = [1]
or: fewer particles;
collision rate decreases;

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(d) **(i)** V^{3+} is oxidant; [1]

(ii) V^{3+} to V^{4+}; [1]
increase in oxidation number / electron loss; [1]

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(c) catalyst would not affect yield / change position of equilibrium / affects both sides equally; [1]
(higher) temperature would reduce yield / increase in temperature would favour back reaction; [1]

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(b) **(i)** Fe to Fe^{2+} [1]
because oxidation is electron loss / increase in oxidation number [1]

(ii) Fe [1]

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5 **(a)** **(i)** rate of reaction decreases / gradient decreases [1]
because concentration of bromine decreases [1]
reaction stops because all bromine is used up [1]

(ii) initial rate greater / gradient greater [1]
because bigger surface area / more particles of iron exposed [1]
or:
final mass the same [1]
because mass of bromine is the same so the same mass of iron is used [1]

(iii) increase / decrease / change rate of stirring / not stirred [1]
measure new rate / compare results [1]

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4 **(a)** rate of forward reaction equals rate of back reaction [1]
concentrations do not change / macroscopic properties remain constant (with time) [1]
accept: amounts

(b) **(i)** increase [1]
reaction 2 [1]
Vr > Vp [1]

(ii) same [1]
reaction 1 [1]
Vr = Vp [1]

(iii) decrease [1]
reaction 3 [1]
Vp > Vr [1]
accept: moles of gas / molecules of gas as an alternative to volume

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(d) **(i)** the reaction is exothermic / reaction produces heat/energy [1]
all the sodium hydroxide used up/neutralised / reaction has stopped [1]

(ii) adding colder acid / no more heat produced [1]
if not given in **(d)(i)** any comments such as "reaction has stopped" can gain mark

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6 (a) (i) does not form compounds / does not accept and does not lose electrons / has full outer shell/has 8e in outer shell / it is a Noble Gas / it is in Group 0/8 [1]

(ii) small number of outer electrons / lose electrons then positive [1]
large number of outer electrons / gain electrons then negative [1]

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(b) (i) with copper / first experiment [1]

(ii) copper acts as a <u>catalyst</u> [1]

(c) (i) smaller gradient [1]
not rate is slower

(ii) same final volume of hydrogen / same level (on graph) [1]

(d) temperature / heat [1]
increase temperature – reaction faster particles have more energy / particles move faster / particles collide more frequently / more particles have enough energy to react
not more excited
accept arguments for a decrease in temperature [1]

powdered
greater surface area
greater collision rate / more particles exposed (to acid)
any **two** [2]
not concentration / light / catalyst / pressure

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6 (a) <u>rates</u> equal [1]
concentrations do not change / macroscopic properties remain constant [1]
accept amounts do not change

(b) endothermic [1]
cond favoured by high temperatures [1]

(c) (i) move to left [1]
cond bigger volume / more moles etc [1]
do not insist on "gas"

(ii) less yellow solid / more brown liquid [1]
accept yellow to brown / less solid more liquid / goes brown