1 **(a (i)** rate at t_2 less than at t_1 **or** the rate decreases (1)

rate at t_3 zero / reaction stopped (1) [2]

(ii) rate at t_2 less than at t_1 because **concentration** of hydrogen peroxide is less at t_2 **or concentration** of hydrogen peroxide is decreasing. (1)

(rate at t_3 zero / reaction stopped because) hydrogen peroxide is used up (1) [2]

(b) (i) steeper and must come from the origin (1)
final volumes the same (1) [2]

(ii) Any **two** from: [2]
steeper curve because of a faster rate
faster rate because of increased surface area
same amount / volume / mass / no of mol of hydrogen peroxide
ecf for M1 for a shallower curve because of slower rate.

(c) filter (and rinse / wash) (1)

dry manganese (IV) oxide (1)

weigh / measure mass manganese(IV) oxide after reaction (1)

the mass should be 0.1 g **or** unchanged. (1) [4]

(d) number of moles of O_2 formed = 0.096 / 24 = 0.004 (1)
number of moles of H_2O_2 in 40 cm^3 of solution = $0.004 \times 2 = 0.008$ (1)

concentration of the hydrogen peroxide in mol / dm^3 = 0.008 / 0.04 = 0.2 (1) [3]

[Total:15]

2 **(a)** **(i)** large / high surface area [1]

high collision rate / collide more / many collisions [1]
(between oxygen molecules and aluminium atoms)
NOT faster collisions

(ii) concentration [1]
of reactants decreases [1]

allow one mark **ONLY** *for:*
for reactants used up **or** amount of reactant decreases

(iii) *any three of four from one strand:*

M1	increase in temperature	
M2	molecules move faster **or**	particles have more energy
M3	higher collision rate	
M4	more successful collisions **or**	more particles have enough energy to react/E_a

[3]

(b) **(i)** flour **or** wood dust **or** coal dust or carbon or sugar [1]

(ii) any three from:
powder and larger pieces / different sized particles use
suitable named solid, e.g. magnesium
suitable named solution, e.g. named acid **or** copper sulfate(aq)
result – powder reacts faster than larger pieces [3]
NOT Cu (with acid); K / Na with anything

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) (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;

(c) (carbon monoxide-incomplete combustion; [1]
carbon - containing fuel / fossil fuel / petrol; [1]

oxides of nitrogen - oxygen and nitrogen react; [1]
at high temperature / in engine; [1]
not: in exhaust

(ii) carbon monoxide to carbon dioxide; [1]
oxides of nitrogen to nitrogen; [1]
correct balanced equation; [1]

[Total: 17]

4 **(a) (i)** correct structure of an isomer e.g. 2-chloropropane; [1]

(ii) chlorine; [1]
light / heat / lead tetraethyl; [1]

(iii) could produce 2-chloropropane; [1]
could produce HC*l*; [1]
or
could produce dichloropropanes = [2]

(b) add silver nitrate / lead nitrate; [1]
yellow precipitate; [1]
note: do not insist on presence of dilute nitric acid

(ii) propanol / propan-1-ol; [1]

(c) (i) for A;
reaction slower;
decreased collision rate;
less bromobutane present / concentration of bromobutane less / less reacting particles; [2]
any two
accept: reverse arguments for B

(ii) halogens C*l* > Br > I reactivity / reactivity decreases down group; [1]
organic halides I > Br > C*l* / reactivity increases down group; [1]
opposite without explanation = [1]

(iii) any three from:
less energy;
particles move slower;
less collisions / fewer particles have energy to react / fewer successful collisions;
slower rate; [3]

[Total: 15]

5 **(a)** **(i)** $2Li + 2HI \rightarrow 2LiI + H_2$ [1]

(ii) zinc carbonate + hydriodic acid $\rightarrow$ zinc iodide + carbon dioxide + water [1]

(iii) $MgO + 2HI \rightarrow MgI_2 + H_2O$ [1

(b) reaction 1 is redox / Li/2HI reaction [1]
cond reason either oxidation number/state / electron transfer [1]

(c) with hydriodic acid – iodine formed / goes dark brown / grey/black solid [1]

not purple vapour **not** purple/black solution

with hydrobromic acid – bromine formed / goes orange / yellow / brown / reddish brown / red / brown vapour [1]

note can accept brown for iodine provided bromine is different orange/brown etc.

(d) 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

(iii) 1.33 / 1.3 / 1.3333 (mol/dm^3) scores both marks [2]
not 1.34
for a correct method – $M_1 V_1$ / moles of NaOH = 0.02
with an incorrect answer **only** [1]