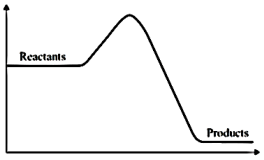
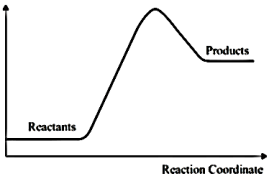
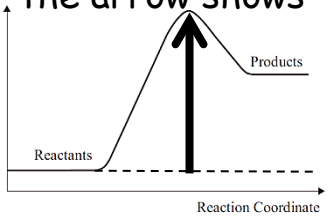
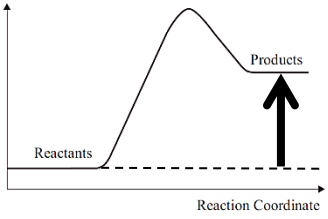
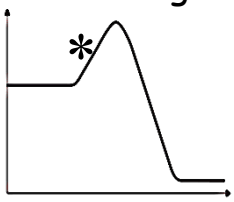
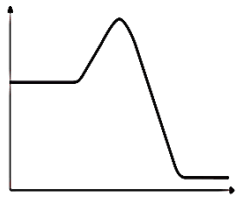
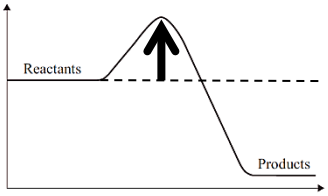
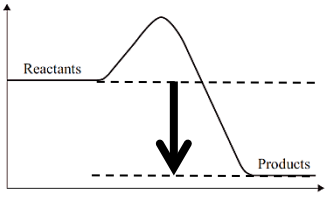
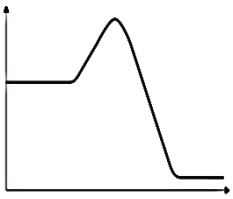
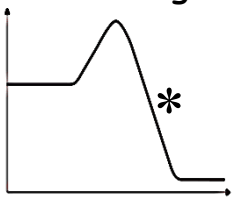
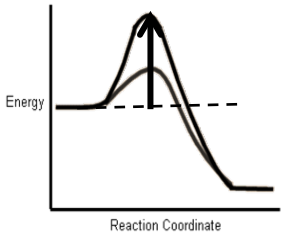
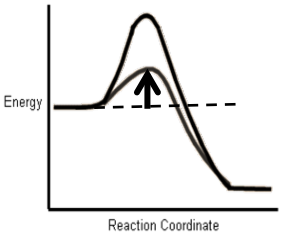
-ΔH means the reaction / process is …..	Reaction / process where energy is released to the surroundings	surroundings warm up / reaction "feels hot" means that the reaction is…	 Exothermic or endothermic?
exothermic	**exothermic**	**exothermic**	**exothermic**
Mg & HCl respiration & combustion are all …. reactions	dissolving NH_4Cl & photosynthesis are both …. processes / reactions	change of state $S \rightarrow L$ & $L \rightarrow G$ are both … processes	change of state $G \rightarrow L$ & $L \rightarrow S$ are both … processes
exothermic	**endothermic**	**endothermic**	**exothermic**
+ΔH means the reaction / process is …..	Definition: Energy is absorbed from the surroundings	surroundings cool down; reaction "feels cold" means the reaction is …	 Exothermic or endothermic?
endothermic	**endothermic**	**endothermic**	**endothermic**
reactants have more energy than the products; the reaction /process is …	reactants have less energy than the products; the reaction /process is …	bond making is always … (exo or endo?)	bond breaking is always… (exo or endo?)
exothermic	**endothermic**	**exothermic**	**endothermic**

units for enthalpy changes	the arrow shows 	the arrow shows 	bond _____ is occurring 
kJ or kJ mol^{-1}	**Ea / activation energy**	**enthalpy change ΔH (+ΔH)**	**breaking**
 the y axis is…	the arrow shows 	the arrow shows 	the x axis is 
energy or enthalpy	**Ea / activation energy**	**enthalpy change ΔH (-ΔH)**	**reaction progress / coordinate**
bond _____ is occurring 	the arrow shows 	**the arrow shows** 	a catalyst lowers the activation energy, Ea, for a reaction by…
making	**Ea uncatalysed**	**Ea catalysed**	**allowing it to occur by an alternative reaction pathway / mechanism**
A catalyst does / does not alter ΔH for a reaction	A_____ increases reaction rate by providing an alternative pathway of lower activation energy so a greater proportion of collisions have the required activation energy and are successful	<u>Surface area</u> Greater surface area ⇒ greater rate because there is an increase in the _____ of particle collisions	<u>Concentration</u> Greater concentration ⇒ greater rate because there is an increase in the _____ of particle collisions
does not	**catalyst**	**frequency**	**frequency**

Pressure (gases) Greater pressure ⇒ greater rate because there is an increase in the _____ of particle collisions	Temperature Greater temp. Particles have more _____ energy and are moving _____	Temperature Greater temp. More collisions more likely to have sufficient energy to overcome the Ea barrier so more _____ collisions/s	Temperature Greater temp. Molecules collide more frequently AND with greater energy so reaction rate ___
frequency	**kinetic faster**	**successful / effective**	**increases**
the fraction of total collisions that actually result in the formation of the product	if the frequency of effective collisions increases, so does the _____ _____	substance that increases the rate of a reaction but is **not consumed** in the reaction	for _____ reactions, **both** forward & reverse reaction rates are affected by the catalyst; E_a for both directions is decreased
effective collisions	**reaction rate**	**catalyst**	**equilibrium / reversible**
$K_c = \frac{[NO]^2}{[N_2][O_2]}$ the reaction was…	$K_c = \frac{[O_2]^3}{[O_3]^2}$ the reaction was..	the Kc expression for the reaction $2NH_3 \rightleftharpoons N_2 + 3H_2$ is…	the Kc expression for the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ is…
$N_2 + O_2 \rightleftharpoons 2NO$	**$2O_3 \rightleftharpoons 3O_2$**	$K_c = \frac{[N_2][H_2]^3}{[NH_3]^2}$	$K_c = \frac{[NH_3]^2}{[H_2]^3[N_2]}$
large Kc the concentration of ___ is high the concentration of ___ is low (as product concentration on top of the ratio)	small Kc the concentration of ___ is high the concentration of ___ is low (as product concentration is on top of the ratio)	Equilibria increase in temperature favours the…	Equilibria decrease in temperature favours the…
products reactants	**reactants product**	**endothermic reaction / reaction that absorbs heat energy**	**exothermic reaction / reaction that releases heat energy**

HCO_3^- is called _____ as it can both donate and accept H^+	HCl is a _____ acid and completely dissociates in solution	CH_3COOH is a _____ acid and only partially dissociates in solution	$HA + H_2O \rightleftharpoons A^- + H_3O^+$
amphiprotic	**strong**	**weak**	**weak acid**
a ___ acid • fully ionises / dissociates in water • reacts completely with water	a ___ acid • partially ionises / dissociates in water • reacts incompletely with water	Brønsted-Lowry definition of an acid	$HA + H_2O \rightarrow A^- + H_3O^+$
strong	**weak**	**proton donor**	**strong acid**
another name for the H^+ ion	the electrical conductivity of HCl will be high, as there will be a large concentration of __ & __ ions in solution.	the electrical conductivity of CH_3COOH will be very low, as there will be a very low concentration of __ & __ ions in solution.	Brønsted-Lowry definition of a base
proton	**H^+ (or H_3O^+) and Cl^-**	**H^+ (or H_3O^+) and CH_3COO^-**	**proton acceptor**
the _____ of an acid is a measure of its ability to donate hydrogen ion / protons	the lower the pH, the _____ the $[H_3O^+]$	HCl & CH_3COOH of the <u>same conc. & volume</u> will react with the same amount of NaOH / Mg / Na_2CO_3 as	$pH = - \log [H^+]$
strength	higher	**the total amount of H_3O^+ ions available in each is the same**	to calculate pH from $[H^+]$

$[H_3O^+] = 10^{-pH}$	pH + pOH =	Kw = 1×10^{-14} is called	$[H^+][OH^-]$ or $[H_3O^+][OH^-]$ =
Equation to calculate $[H_3O^+]$ from pH	**14**	**the ionic product for water**	**Kw / 1×10^{-14}**
$= \frac{1 \times 10^{-14}}{[OH^-]}$	$= \frac{1 \times 10^{-14}}{[H_3O^+]}$	pOH = - log $[OH^-]$	Concentration of $[H_3O^+]$ in a strong acid eg HCl is equal…
$[H_3O^+]$	**$[OH^-]$**	to calculate pOH from $[OH^-]$	**to the concentration of the acid (in mol L^{-1})**
<u>Equilibria</u> increase in [reactant] favours the…	<u>Equilibria</u> increase in [product] favours the…	rate of the forward reaction = rate of backward reaction: we call this ___ equilibrium	Concentration of $[OH^-]$ in a strong alkali/base eg NaOH is equal…
forward reaction / reaction that uses up the reactant, to minimise the change	**back reaction / reaction that uses up the product, to minimise the change**	**dynamic**	**to the concentration of the alkali/base (in mol L^{-1})**
increase in pressure causes equilibrium to shift to ___ the no. of **gaseous** particles, shifts eqm. to side with ___ number of moles of gas	decrease in temp. causes an equilibrium shift to favour reaction that _____ energy, ie shift in the _____ direction.	endothermic reactions will be favoured by ___ temperatures but the reaction rate is too ___	<u>endothermic reactions</u> producing a sufficiently high % product in a short time requires a _____
reduce least/smaller	**releases exothermic**	**low slow**	**compromise temp. (less % product & fast reaction rate)**

$\Delta_r H$	solution containing the NH_4^+ ion would be a weak _____ as NH_4^+ is a proton _____	solution containing the CH_3COO^- ion would be a weak _____ as CH_3COO^- is a proton _____	equation for HCO_3^- acting as a base is…
enthalpy change for the reaction	**acid donor**	**base acceptor**	**$HCO_3^- + H_2O \rightleftharpoons H_2CO_3 + OH^-$**
conjugate acids and bases differ by a …	the conjugate acid of NH_3 is	the conjugate acid of HCO_3^- is	the conjugate base of HCO_3^- is
proton / H^+	**NH_4^+**	**H_2CO_3**	**CO_3^{2-}**
the conjugate base of CH_3COOH is	the conjugate base of H_2O is …..	equation for **CH_3COO^-** acting as a base is…	2.86×10^{-13} is given to ___ s.f.
CH_3COO^-	**OH^-**	**$CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-$**	**3**
write pH 3.467 to 3 s.f.	write pH 3.5 to 3 s.f.	entering a number like 1.25×10^{-3} in calculator….	writing a number like 3.4562E-04 as seen in calculator to 3 sf
3.47	**3.50**	**1 . 2 5 EXP (-) 3**	**3.46×10^{-4}**